A

CYCLOPÆDIA

OF

PRACTICAL RECEIPTS

AND COLLATERAL INFORMATION

COOLEY'S CYCLOPÆDIA

OF

PRACTICAL RECEIPTS

AND

COLLATERAL INFORMATION

IN THE

ARTS, MANUFACTURES, PROFESSIONS, AND TRADES

INCLUDING

Medicine, Pharmacy, Hygiene, and Domestic Economy

DESIGNED AS A COMPREHENSIVE

SUPPLEMENT TO THE PHARMACOPŒIA

AND

GENERAL BOOK OF REFERENCE

FOR THE MANUFACTURER, TRADESMAN, AMATEUR, AND
HEADS OF FAMILIES

SEVENTH EDITION

REVISED AND GREATLY ENLARGED BY

W. NORTH, M.A.Camb., F.C.S.

VOL. I

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PREFACE TO THE SEVENTH EDITION

In the preparation of the present edition of 'Cooley's Cyclopædia,' the object kept in view has been the revision and amplification of the matter originally contained in the work rather than the enlargement of its scope.

The more important additions to the work will be found under Photography, Surveying, and Insects Injurious to Crops. The old article on Photography has been entirely re-written and greatly enlarged, and a collection of formulæ and processes from the very best authorities of the present day has been included in it, which it is hoped will prove useful, not only to the amateur, but also to the professional.

Surveying appeared to demand a place in a book which is largely used by country gentlemen and colonists, and though the methods given are chiefly those used for military purposes, my own practical experience of the value of these methods for purely civil purposes, and the opportunity offered of reproducing the more important cuts and diagrams from Colonel Richards' work on 'Military Topography,' has led me to deal with the subject from this point of view at some length.

The important new feature in this edition is the series of articles on Insects Injurious to Crops, which are practically a reprint of reports made by Mr Chas. Whitehead, F.Z.S., to the Agricultural Department of the Privy Council and to the Board of Agriculture. These articles are reproduced by special permission of the Board, "The Board being anxious to encourage the spread of agricultural information, and Mr Whitehead and the Controller of Her Majesty's Stationery Office having expressed to the Board that no objection would be taken to the publication," provided the same be duly acknowledged. In compliance with this request each article is formally acknowledged thus—Reports on Insects Injurious to Crops, by Chas. Whitehead, Esq., F.Z.S. The subject is one worthy of the closest attention by all agriculturists, and I would here express to Mr Chas. Whitehead and to the Board of Agriculture my most grateful thanks for the permission accorded.

The revision of the Pharmacy, one of the most important divisions of the work, has been carried out very thoroughly by my friend, Mr. A. W. Gerrard, Pharmacist to University College Hospital. Great additions have been made, and nothing has been removed in any way likely to be of practical utility. The character of 'Cooley's Cyclopædia' as a pharmaceutical reference-book has always been considerable, and no effort has been spared to keep it well up to the mark in this respect.

The general Chemistry has been most thoroughly revised by various hands, and brought well up to date. Special attention has been paid throughout to all commercial and practically useful methods and processes, whilst, at the same time, the scientific aspect of the various branches of the subject

has not been neglected. The work was begun by Dr G. McGowan, of Bangor, carried on by Messrs W. K. Tompkins, B.Sc., E. P. Perman, B.Sc., and C. F. Baker, B.Sc., of University College, London, and completed by Mr J. T. Norman.

The Veterinary Medicine has been considerably modified and brought more into harmony with modern practice. The Domestic Medicine has been advisedly reduced, and detailed accounts of many diseases and modes of treatment have been removed in all cases in which the supervision of a qualified medical practitioner is necessary or desirable. The gaps thus caused have been more than filled by practical information on first aid to the sick and injured.

The general receipts throughout the work have been carefully revised and largely added to, and it is believed much increased in practical value.

To enumerate all the works consulted would be well nigh impossible. In the majority of cases the source of information is acknowledged in the body of the work, and I would here acknowledge special indebtedness to Sir Richard Quain's 'Dictionary of Medicine' and Professor Williams' 'Veterinary Medicine,' which have been freely consulted as authorities on the respective subjects.

It only remains for me to express my gratitude to my coadjutors in the Chemistry and Pharmacy, and to many friends for information freely given on various technical matters, and last, but by no means least, to the printers, whose skill and ever ready help has done much to lighten a very heavy task.

I have myself read and corrected the whole of the proofs of this edition; that errors should have crept in in dealing with such a mass of material is inevitable, but it is believed that they are few in number and of minor importance.

In conclusion, I venture to express the hope that in this new edition the sphere of usefulness of 'Cooley's Cyclopædia' may be considerably increased.

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PREFACE

THE design of the present work is briefly, but not completely expressed in its title-page. Independently of a reliable and comprehensive collection of formulæ and processes in nearly all the industrial and useful arts, it contains a description of the leading properties and applications of the substances referred to, together with ample directions, hints, data, and allied information, calculated to facilitate the development of the practical value of the book in the shop, the laboratory, the factory, and the household. Notices of the substances embraced in the Materia Medica of our national pharmacopœias, in addition to the whole of their preparations, and numerous other animal and vegetable substances employed in medicine, as well as most of those used for food, clothing, and fuel, with their economic applications, have been included in the work. The synonymes and references are other additions which will prove invaluable to the reader. Lastly, there have been appended to all the principal articles referred to brief, but clear, directions for determining their purity and commercial value, and for detecting their presence and proportions in compounds.

The sources from which I have derived the vast mass of materials forming this volume are such as to render it deserving the utmost confidence. I have invariably resorted to the best and latest authorities, and have consulted almost innumerable volumes, both British and foreign, during its compilation. Secondary channels of information have been scarcely ever relied on when original authorities were within my reach. A large portion of the work has been derived from my personal experience and observations in the departments of applied chemistry and hygiene, and from the processes of various laboratories and manufactories, many of which I can the more confidently recommend from having either inspected or witnessed their employment on an extensive scale. The indiscriminate adoption of matter, without examination, has been uniformly avoided, and in no instance has any formula or process been admitted into this work, unless it rested on some well-known fact of science, had been sanctioned by usage, or come recommended by some respectable authority. The settlement of doubtful or disputed points has often occupied me a greater number of hours, and not unfrequently a greater number of days, than that of the lines of letter-press which convey the results to the public. In all cases precedence has been given to the standard formulæ of our national pharmacopœias, and to those processes which long experience, or well-conducted experiments, have shown to be the most successful, profitable, and trustworthy. In general, the sources of information have been indicated, for the purpose of enabling the reader to form a better estimation of their value. Whenever this is not the case, in reference to borrowed formulæ and data,

the omission has arisen from the impossibility of determining to whom the merit is justly due.

I have endeavoured as much as possible, in the present work, to avoid confusion of the medical weights with those commonly used in trade and commerce—an attempt which, so far as I am aware, has not been successfully carried out in any other quarter. For this purpose I determined to entirely abandon the usual arbitrary signs or characters employed to represent the divisions of the apothecaries' pound, and to distinguish the two weights from each other, by simply printing, in different type, the plain English names and abbreviations representing their several denominations. The medical signs for the imperial gallon and its subdivisions have also been abandoned for their common English names. It would have afforded me pleasure to have reduced all the quantities to one uniform standard, had it been practicable, or, in all cases, advisable.

Under the names of most of the leading diseases that could be profitably noticed in the present work, such explanations and directions have been given as accord with the prevailing opinions and practice of the faculty at the present day. These, when judiciously applied, will prove invaluable to emigrants, travellers, voyagers, and other parties beyond the reach of legitimate medical assistance; and, under opposite circumstances, will, in general, enable those who have the care of the sick the better to second and carry out the instructions and efforts of the physician for the benefit of their charge. Here, however, it may be useful to repeat the cautions given in other parts of this volume, as to the impropriety of unnecessarily meddling with the healing art, or neglecting a prompt application to a duly qualified practitioner, in all cases demanding either medical or surgical aid. It is an indubitable fact that the best efforts of the inexperienced and uninitiated in the mysteries of medical science must be always enormously behind those of parties whose whole lives and study have been devoted to the subject.

The nature of a condensed alphabetical arrangement not permitting numerous articles to come under distinct heads, or to be referred to under all their synonymes, the casual reader may often be led to suppose that this book is most deficient where in reality it is the most copious. In general I have attempted, as much as possible, to bring together subjects of a closely allied character, and compounds which are analogous to each other, either in constitution or the mode of their preparation. Thus, most of the formulæ for Mixtures, Ointments, Pills, &c., follow in alphabetical order the general articles under these heads; whilst those for the Oxides, Salts, &c., follow the names of their respective bases. In like manner, a notice of a number of preparations will be found included in that of their principal ingredients. The names under which the leading substances appear are generally those which are most familiar to well-informed practical men, and which have commonly reference to either their acknowledged chemical constitution, or to some long-known and easily recognised quality. The following extract conveys an important lesson on this subject, with which I perfectly agree:—"We have been unwilling to make any unnecessary changes in the nomenclature of substances whose names are sanctioned by the usage of the present day; for these names have been, for the most part, rightly assigned by our predecessors, or confirmed by lapse of time. We are, indeed, aware that every improvement in the knowledge of things ought to be embodied

in their names; but we must be careful, in selecting or forming these names, not to make those points appear certain and established which are as yet doubtful, for it is safer to be in the rear than advance of natural history." *

I have exerted myself to the utmost to ensure the accuracy and completeness of this volume; but I feel conscious that, after all my efforts for this purpose, some errors have crept into it, that many subjects which deserve insertion in it have been omitted, and that many others have been either imperfectly or too briefly noticed. "Yet these failures, however frequent, may," I trust, "admit of extenuation and apology. To have attempted much is always laudable, even where the enterprise is above the strength that undertakes it. To rest below his aim is incident to every one whose fancy is active, and whose views are comprehensive; nor is any man satisfied with himself because he has done much, but because he conceives little." When I commenced this work I resolved to leave nothing within its legitimate limits unexamined or unelucidated; and I flattered myself with a prospect of the hours which I should thus "revel away" in a pursuit so congenial to my desires—"the treasures with which I expected every search into those neglected mines to reward my labour—and the triumph with which I should display my acquisitions to mankind. But these were the dreams of a poet, doomed at last to wake a" Cyclopædist. The long task which I had undertaken soon exhibited its truly onerous character, and daily grew in urgency, until that which promised to be a pleasure had been transformed into an exhausting and continuous labour. At first a sacrifice of the hours of leisure only seemed necessary to the undertaking; next, those assigned to professional and business avocations were demanded and absorbed; but ere long, one by one, the hours usually devoted to repose were sucked into the insatiable vortex, until the bright beams of the rising sun not unfrequently illumined the lamp-lit study or the gloomy laboratory, and surprised the author, no longer an enthusiast, at his still-enduring task. But long ere this I had learned that to carry out my original resolutions in all their completeness and entirety was impossible, and "that to pursue perfection was, like the first inhabitants of Arcadia, to chase the sun, which, when they had reached the hill where he had seemed to rest, was still at the same distance from them." † All I can further say in reference to this point is simply to assure the reader that three of the elements usually deemed essential to give value to a technological work—viz. zeal, industry, and capital—have not been wanting in the production of the present one: the first two depending on the author, and the other chiefly on the liberality and enterprise of the publisher.

As heretofore, I beg to solicit my readers to apprise me of any inaccuracies or omissions in this volume which may come beneath their notice. I shall also thankfully receive any hints or suggestions tending to the improvement of future editions of this work. Such communications, to be useful, must, however, be written on only one side of the paper. Parties who may thus kindly afford me assistance will, in due course, have their services publicly acknowledged; and their names and addresses, unless when otherwise requested, will be published in full.

I have endeavoured to render the present volume as self-explanatory as

* Preface to the Ph. L., 1851.

† Dr Samuel Johnson's Preface to his English Dictionary.

possible, and, in general, have appended ample directions to the several formulæ and processes that seemed to me likely to cause embarrassment to those inexpert in chemical manipulation; but should any party find it otherwise, I shall be happy to reply gratuitously to any reasonable questions tending to elucidate the difficulty.

In conclusion, I may add that, having now for nearly a quarter of a century devoted my attention to the applications of chemistry in most of the useful arts and manufactures, both British and foreign, and in sanitation, I am in possession of many valuable processes and formulæ, hitherto wholly unknown or but partially developed, with various improved plans of factories, laboratories, ventilation, &c., which the limits of this work will not permit me to describe in its pages, but on which I should be happy to communicate with parties interested in the same. Persons desirous of establishing any new branch of manufacture, or of improving an existing one, or of determining the purity or value of articles of food, wines, liqueurs, medicines, &c., or of obtaining formulæ or processes which are not contained in this work, may, in like manner, have their wishes complied with, by enclosing to me samples or the requisite information.

ARNOLD J. COOLEY.

ABBREVIATIONS, ETC., USED IN THIS WORK

THESE, for the most part, consist of the first syllable, or the initial letter or letters of the words they stand for. As *Prep.*, preparation; *Pur.*, purity; *Purif.*, purification; *Obs.*, observations; *Var.*, varieties, &c.—Ph. stands for *pharmacopœia;* B. P., for *British Pharmacopœia;* Ind. Ph., for *Indian Pharmacopœia;* Cod., for *Codex.*—L., E., D., P., U. S., &c., associated with the last two abbreviations, are the initial letters of the cities and countries which produce the respective works; as, London, Edinburgh, Dublin, Paris, United States, &c. When no dates are given, the last editions of the pharmacopœias are referred to.

lb., oz., dr., respectively represent the *pound, ounce,* and *drachm* ($\frac{1}{8}$ oz.), AVOIRDUPOIS WEIGHT. This is the only weight employed in the British and last Dublin Pharmacopœias.

lb., oz., dr., and gr., refer to the *pound, ounce, drachm,* and *grain,* APOTHECARIES' or TROY WEIGHT.

The word '*drop*' in all cases indicates a measured drop or minim.

The *names of individuals* which appear in this work are those to whom the immediately attached information or formula is usually attributed, or on whose recommendation or authority it has been selected.

′ denotes the *accented vowel* or *syllable.*

″ „ that the following consonant coalesces with the preceding letter in utterance.

† „ that the name or the definition to which it is attached is '*obsolete.*'

* „ „ „ „ „ *becoming obsolete,* little used, or objectionable.

‡ „ that the name or the definition to which it is attached is '*colloquial,*' or popular, or used only in trade.

§ „ that the name or the definition to which it is attached is '*vulgar.*'

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A-, ab-, abs-. [L.] In *composition*, from; denoting distance, departure, separation, or opposition; as in *aberration, abstraction, abnormal*, &c.

A-, an-. [Gr.] In *composition*, no, not, without; denoting the absence or loss of some quality or thing; as in *achromatic, anhydrous, amorphous*, &c.

AB'ACA or ABAKA (kă*h*). The native name of the plant (*Musa textilis*) which produces Manila or Philippine Islands' hemp. Manila hemp is remarkable for its strength and durability, and is invaluable for the manufacture of the best kinds of hawsers and towing cables for ships' use. There are several varieties of the plant, some of which produce a fibre sufficiently fine to admit of its being woven into delicate fabrics such as muslin. Its chief use, however, is for the production of mats, cordage, sail-cloth, netting, hammocks, and the like, in which a combination of great strength with lightness and durability are desirable qualities. Of late years Manila (or Manilla) has come extensively into use for the manufacture of envelopes for documents and bankers' pass-books, the divisions of letter-files, and all purposes for which a very tough and almost untearable paper is desirable. It is to a large extent superseding the so-called linen-lined papers. The method of preparation of the fibre is very similar to that used for flax, q. v., the fibre, and fabrics made from it, may be bleached and dyed in a similar manner to flax and linen.

ABATTOIR (Fr. abattre = to kill). A slaughter-house or place where animals are killed, as distinguished from *boucherie*, the place in which the meat is offered for sale. Modern sanitary legislation is tending in the direction of public as against private slaughter-houses. Paris was the first town of any size to realise the necessity of keeping abattoirs separate from dwelling-houses, and a decree was promulgated in 1567 for their construction and regulation. In 1810 a commission authorised the construction of abattoirs outside Paris, and five were built. Under an Act of Parliament, passed in 1850, public slaughter-houses were erected in Edinburgh. The Islington abattoir and market in London was opened by Prince Albert in 1855. See SLAUGHTER-HOUSE.

ABBREVIATION. One or more of the earlier letters of a word used to express the whole.

1. **Abbreviations in general use:—**

A.B., Bachelor of Arts.—Able Bodied Seaman.

A.C., Ante Christum, before Christ.

A.D., In the year of our Lord.

A.I.C., Associate of the Institute of Chemistry.

A.I.C.E., Associate of the Institute of Civil Engineers.

A.M., Master of Arts.—Before noon.

A.R.A., Associate of the Royal Academy.

A.U.C., In the year of the founding of the City (of Rome).

B.A., Bachelor of Arts.

Bart., Baronet.

B.C., Before Christ.

B.C.L., Bachelor of Common Law.

B.D., Bachelor of Divinity.

B.Sc., Bachelor of Science.

C.B., Companion of the Bath.

C.E., Civil Engineer.

C.M.G., Companion of the Order of St Michael and St George.

C.S., Civil Service.

D.C.L., Doctor of Civil Laws.

D.D., Doctor of Divinity.

D.G., By the Grace of God.

Dr., Doctor.—Debtor.

D.O.M., Deo Optimo Maximo.—To God the Best and Greatest.

D.Sc., Doctor of Science.

D.V., God willing.

Ed., Editor, or Edition.

e. g., for example.

F.C.P., Fellow of the College of Preceptors.

F.C.S., Fellow of the Chemical Society.

F.G.S., Fellow of the Geological Society.

F.K.Q.C.P.I., Fellow of the King's and Queen's College of Physicians of Ireland.

F.I.C., Fellow of the Institute of Chemistry.

F.L.S., Fellow of the Linnean Society.

F.M., Field Marshal.

F.R.A.S., Fellow of the Royal Astronomical Society.

F.R.C.P., Fellow of the Royal College of Physicians.

Abbreviations in general use (*continued*):—

F.R.C.S., Fellow of the Royal College of Surgeons.

F.R.G.S., Fellow of the Royal Geographical Society.

F.R.S., Fellow of the Royal Society.

F.R.S.E., Fellow of the Royal Society of Edinburgh.

H.M.S., Her Majesty's Ship.

H.R.H., His (or Her) Royal Highness.

i. e., That is.

Inst., Instant (the present month).

I.H.S., Jesus the Saviour of Man.

K.B., Knight of the Bath.

K.C.B., Knight Commander of the Bath.

K.G., Knight of the Garter.

Knt., Knight.

K.StP., Knight of St Patrick.

K.T., Knight of the Thistle.

L.A.C., Licentiate of the Apothecaries' Company.

Lat., Latitude.

L.D., Licentiate in Dentistry.

L.D.S., Licentiate in Dental Surgery.

LL.D., Doctor of Laws.

L.M., Licentiate in Midwifery.

Loc. cit., the part referred to.

Lon. or Long., Longitude.

M.A., Master of Arts.

M.B., Bachelor of Medicine.

M.C., Master of Surgery.—Master of the Ceremonies.—Member of Congress.

M.C.P., Member of the College of Preceptors.

M.D., Doctor of Medicine.

M.I.B.A., Member of the Institute of British Architects.

M.P., Member of Parliament.

M.R.C.P., Member of the Royal College of Physicians.

M.R.C.S., Member of the Royal College of Surgeons.

M.R.C.V.S., Member of the Royal College of Veterinary Surgeons.

M.R.I., Member of the Royal Institution.

M.R.I.A., Member of the Royal Irish Academy.

MS., Manuscript.

MSS., Manuscripts.

Mus. Doc., Doctor of Music.

N.B., Mark well.

Nem. con., Without opposition.

O.H.M.S., On Her Majesty's Service.

Op. cit., The work quoted.

Per cent. (often expressed by the sign $\frac{0}{0}$ or %), By, or in, the hundred.

Ph.D., Doctor of Philosophy.

P.M., Afternoon.

Prox., The next (month).

P.S., Postscript.

Q.C., Queen's Counsel.

Qy. (?), Query, Question.

R.A., Royal Academician.—Royal Artillery.

R.E., Royal Engineers.

R.H.A., Royal Horse Artillery.

R.M., Royal Marines.

R.N., Royal Navy.

T.C.D., Trinity College, Dublin.

Tr., Translator.

Ult., The last (month).

Abbreviations in general use (*continued*):—

v. or vide, See.

q. v., Which see.

W.S., Writer to the Signet.

&, *ampersand*, and.

&c., et cetera, And so on.

2. **Abbreviations used in Prescriptions**:—

A. aa., ana (Greek), of each. Equally by weight or measure.

Abdom., Abdomen, the abdomen, the belly.

Abs. febr., absente febre, fever being absent.

Ad 2 vic., ad secundum vicem, to the second time; or *ad duas vices,* for two times.

Ad gr. acid., ad gratam aciditatem, to an agreeable acidity.

Ad def. animi, ad defectionem animi, to fainting.

Ad del. an., ad deliquium animi, to fainting.

Ad libit., ad libitum, at pleasure.

Add., adde, or *addantur,* add, or let them be added; *addendus,* to be added.

Adjac., adjacens, adjacent.

Admov., admove, admoveatur, admoveantur, apply, let it be applied, let them be applied.

Ads. febre, adstante febre, while the fever is present.

Alter. hor., alternis horis, every other hour.

Alvo adstr., alvo adstrictâ, when the bowels are confined.

Aq. astr., aqua astricta, frozen water.

Aq. bull., aqua bulliens, boiling water.

Aq. com., aqua communis, common water.

Aq. fluv., aqua fluviatilis, river water.

Aq. mar., aqua marina, sea water.

Aq. niv., aqua nivalis, snow water.

Aq. pluv., aqua pluviatilis, or *pluvialis,* rain water.

Aq. ferv., aqua fervens, hot water.

Aq. font., aqua fontana, or *aqua fontis,* spring water.

Bis ind., bis in dies, twice a day.

Bib., bibe, drink.

BB., Bbds., Barbadensis, Barbadoes, as *aloë Barbadensis.*

B.M., balneum mariæ, or *balneum maris,* a warm-water bath.

B. P., or *B. Ph.,* British Pharmacopœia.

But., butyrum, butter.

B.V., balneum vaporis, a vapour bath.

Cærul., cæruleus, blue.

Cap., capiat, let him (or her) take.

Calom., calomelas, calomel, subchloride of mercury.

C. C., cornu cervi, hartshorn; it may also signify *cucurbitula cruenta,* the cupping-glass with scarificator.

C. C. U., cornu cervi ustum, burnt hartshorn.

Cochleat., cochleatim, by spoonfuls.

Coch. ampl., cochleare amplum, a large (or table) spoonful; about half a fluid ounce.

Coch. infant., cochleare infantis, a child's (or tea) spoonful.

Coch. magn., cochleare magnum, a large spoonful.

Coch. med., cochleare medium, / *Coch. mod., cochleare modicum,* } a middling or moderate spoonful; that is, a dessert-spoonful — about two fluid drachms.

Coch. parv., cochleare parvum, a small (or tea) spoonful; it contains about one fluid drachm.

Abbreviations used in Prescriptions (*continued*):—

Col., cola, strain.

Col., colatus, strained.

Colet., coletur, colat., colatur, let it be strained; *colaturæ,* to the strained liquor.

Colent., colentur, let them be strained.

Color., coloretur, let it be coloured.

Comp., compositus, compounded.

Cong., congius, a gallon.

Cons., conserva, conserve; also (*imperat. of conservo*) keep.

Cont. rem., or *med., continuentur remedia,* or *medicamenta,* let the remedies, or the medicines, be continued.

Coq., coque, boil; *coquantur,* let them be boiled.

Coq. ad med. consumpt., coque or *coquatur ad medietatis consumptionem,* boil, or let it be boiled to the consumption of one half.

Coq. S. A., coque secundum artem, boil according to art.

Coq. in S. A., coque in sufficiente quantitate aquæ, boil in a sufficient quantity of water.

Cort., cortex, bark.

C. v., cras vespere, to-morrow evening.

C. m. s., cras mane sumendus, to be taken to-morrow morning.

C. n., cras nocte, to-morrow night.

Crast., crastinus, for to-morrow.

Cuj., cujus, of which.

Cujusl., cujuslibet, of any.

Cyath. theæ, cyatho theæ, in a cup of tea.

Cyath., cyathus, vel *C. vinar., cyathus vinarius,* a wine-glass; from an ounce and half to two ounces and half.

Deaur. pil., deaurentur pilulæ, let the pills be gilt.

Deb. spiss., debitur spissitudo, due consistence.

Dec., decanta, pour off.

Decub. hor., decubitûs hora, at the hour of going to bed, or at bedtime.

De d. in d., de die in diem, from day to day.

Deglut., deglutiatur, let it be swallowed.

Dej. alv., dejectiones alvi, stools.

Det., detur, let it be given.

Dieb. alt., diebus alternis, every other day.

Dieb. tert., diebus tertiis, every third day.

Dil., dilue, dilutus, dilute (thin), diluted.

Diluc., diluculo, at break of day.

Dim., dimidius, one half.

D. in 2 plo., deter in duplo, let it be given in twice the quantity.

D. in p. æq., dividatur in partes æquales, let it be divided in equal parts.

D. P., directione propria, with a proper direction.

Donec alv. bis dej., donec alvus bis dejecerit, until the bowels have been twice opened.

Donec alv. sol. fuer., donec alvus soluta fuerit, until the bowels have been loosened.

Donec dol. neph. exulav., donec dolor nephriticus exulaverit, until the nephritic pain has been removed.

D., dosis, a dose.

Eburn., eburneus, made of ivory.

Ed., edulcorata, edulcorated.

Ejusd., ejusdem, of the same.

Elect., electuarium, an electuary.

Enem., enema, a clyster.

Exhib., exhibeatur, let it be administered.

Abbreviations used in Prescriptions (*continued*):—

Ext. sup. alut. moll., extende super alutam mollem, spread upon soft leather.

F., fac, make; *fiat, fiant,* let it be made; let them be made.

F. pil., fiant pilulæ, let pills be made.

Fasc., fasciculus, a bundle.

Feb. dur., febre durante, during the fever.

Fem. intern., femoribus internis, to the inside of the thighs.

F. venæs., fiat venæsectio, let venesection be performed.

F. H., fiat haustus, let a draught be made.

Fict., fictilis, earthen.

Fil., filtrum, a filter.

Fist. arm., fistula armata, a clyster-pipe and bladder fitted for use.

Fl., fluidus, fluid.

F. L. A., fiat lege artis, let it be made by the rules of art.

F. M., fiat mistura, let a mixture be made.

F. S. A., fiat secundum artem, let it be made according to art.

Gel. quav., gelatina quavis, in any jelly.

G. G. G., gummi guttæ gambæ, gamboge.

Gr., granum, a grain; *grana,* grains.

Gr. vj pond., grana sex pondere, six grains by weight.

Gtt., gutta, a drop; *guttæ,* drops.

Gtt. quibusd., guttis quibusdam, with some drops.

Guttat., guttatim, by drops.

Har. pil. sum. iij, harum pilularum sumantur tres, of these pills let three be taken.

H. D. or *hor. decub., horâ decubitûs,* at bed-time.

H. P., haustus purgans, purging draught.

H. S., horâ somni, at the hour of going to sleep.

Hor. un. spatio, horæ unius spatio, at the expiration of one hour.

Hor. interm., horis intermediis, in the intermediate hours.

Hor. 11mâ mat., horâ undecimâ matutinâ, at 11 o'clock in the morning.

Ind., indies, daily.

In pulm., in pulmento, in gruel.

In. Ph., Indian Pharmacopœia.

Inf., infunde, infuse.

Inj. enem., injiciatur enema, let a clyster be thrown up.

Jul. julepus, julapium, a julep.

Kal. ppt., kali præparatum, prepared kali (*potassæ carbonas*).

Lat. dol., lateri dolenti, to the affected side.

M., misce, mix; *mensurâ,* by measure; *manipulus,* a handful; *minimum,* a minim.

Mane pr., mane primo, early in the morning.

Man., manipulus, a handful.

Min., minimum, a minim, the 60th part of a drachm measure.

M. P., massa pilularum, a pill mass.

M. R., mistura, a mixture.

Mic. pan., mica panis, crumb of bread.

Mitt., mitte, send; *mittantur,* let them be sent.

Mitt. sang. ad ℥xij, mitte sanguinem ad ℥xij, take blood to twelve ounces.

Mod. præscr., modo præscripto, in the manner directed.

Abbreviations used in Prescriptions(*continued*):—

Mor. dict., *more dicto,* in the way ordered.

Mor. sol., *more solito,* in the usual way.

Ne tr. s. num., *ne tradas sine nummo,* do not deliver it without the money.

No., *numero,* in number.

N. M., *nux moschata,* a nutmeg.

O., *octarius,* a pint.

Ol. lini s. i., *oleum lini sine igne,* cold-drawn linseed oil.

Omn. hor., *omni horâ,* every hour.

Omn. bid., *omni biduo,* every two days.

Omn. bih., *omni bihorio,* every two hours.

O. M., or *omn. man.*, *omni mane,* every morning.

O. N., or *omn. noct.*, *omni nocte,* every night.

Omn. quadr. hor., *omni quadrante horæ,* every quarter of an hour.

O. O. O., *oleum olivæ optimum,* best olive oil.

Ov., *ovum,* an egg.

Oz., the ounce avoirdupois.

P. æ., *part. æqual.*, *partes æquales,* equal parts.

P. d., *per deliquium,* by deliquescence.

Part. vic., *partitis vicibus,* in divided doses.

Past., *pastillus,* a pastil, or ball of paste.

P., *pondere,* by weight.

Ph. D., *Pharmacopœia Dubliniensis.*

Ph. E., *Pharmacopœia Edinensis.*

Ph. L., *Pharmacopœia Londinensis.*

Ph. U.S., *Pharmacopœia of the United States.*

Per. op. emet., *peractâ operatione emetici,* the operation of the emetic being over.

Pocul., *poculum,* a cup.

Pocill., *pocillum,* a small cup.

Post sing. sed. liq., *post singulas sedes liquidas,* after every loose stool.

Ppt., *præparata,* prepared.

P. r. n., *pro re nata,* occasionally.

P. rat. ætat., *pro ratione ætatis,* according to the age.

Pug., *pugillus,* a pinch, a gripe between the thumb and the two first fingers.

Pulv., *pulvis, pulverizatus,* a powder pulverised.

Q. l., *quantum lubet,* } as much as you
Q. p., *quantum placet,* } please.

Q. s., *quantum sufficiat,* as much as may suffice.

Quor., *quorum,* of which.

Q. V., *quantum vis,* as much as you will.

Red. in pulv., *redactus in pulverem,* reduced to powder.

Redig. in pulv., *redigatur in pulverem,* let it be reduced into powder.

Reg. umbil., *regio umbilici,* the umbilical region.

Repet., *repetatur,* or *repetantur,* let it, or them, be repeated.

S. A., *secundum artem,* according to art.

Scat., *scatula,* a box.

S. N., *secundum naturam,* according to nature.

Semidr., *semidrachma,* half a drachm.

Semih., *semihora,* half an hour.

Sesunc., *sesuncia,* half an ounce.

Sesquih., *sesquihora,* an hour and a half.

Si n. val., *si non valeat,* if it does not answer.

Si op. sit, *si opus sit,* if it be necessary.

Si vir. perm., *si vires permittant,* if the strength allow it.

Signat., *signatura,* a label.

Abbreviations used in Prescriptions(*continued*):—

Sign. n. pr., *signetur nomine proprio,* let it be written upon, let it be signed with the proper name (not the trade name).

Sing., *singulorum,* of each.

S. S. S., *stratum super stratum,* layer upon layer.

Ss., *semi,* a half.

St., *stet,* let it stand; *stent,* let them stand.

Sub fin. coct., *sub finem coctiones,* towards the end of boiling, when the boiling is nearly finished.

Sum. tal., *sumat talem,* let the patient take one such as this.

Summ., *summitates,* the summits or tops.

Sum., *sume, sumat, sumatur, sumantur,* take, let him or her take, let it be taken, let them be taken.

S. V., *spiritus vini,* spirit of wine.

S. V. R., *spiritus vini rectificatus,* rectified spirit of wine.

S. V. T., *spiritus vini tenuis,* proof spirit.

Tabel., *tabella,* a lozenge.

Temp. dext., *tempori dextro,* to the right temple.

T. O., *tinctura opii,* tincture of opium.

T. O. C., *tinctura opii camphorata,* camphorated tincture of opium.

Tra., *tinctura,* tincture.

Ult. præscr., *ultimo præscriptus,* last prescribed.

U.S. Ph., United States' Pharmacopœia.

V. O. S., *vitello ovi solutus,* dissolved in the yolk of an egg.

Vom. urg., *vomitione urgente,* the vomiting being troublesome.

V. S. B., *venæsectio brachii,* bleeding from the arm.

Zz., *zingiber,* ginger.

See Formula, Prescriptions, Symbols, &c.

ABDO'MEN. [Eng., Fr., L.] In *anatomy,* the belly, or lower belly; the great cavity of the body extending from the thorax, or chest, to the bottom of the pelvis. It contains the stomach, intestines, liver, spleen, kidneys, bladder, &c.; and in the female, the uterus, ovaria, &c.

ABDOMINALES, or ABDOMINAL FISHES. A subdivision of the Malacopterygious order, whose ventral fins are placed behind the pectorals, under the abdomen.—*Types.* Carp, Salmon, Herring, Pike.

ABDUCTION. In *anatomy,* indicates movement of a limb *from* the mesial plane of the body; when used of the fingers or toes, it signifies movement *from* the middle line of the hand or foot respectively.

AB'ERNE'THY MEDICINES. These originally consisted of a calomel pill, and subsequently of a mercurial or 'blue' pill, to be taken over-night, followed by an aromatised black draught in the morning. The quantity of either of the former, for an adult, was about 3 gr. to 3½ gr., increased a little in bulk by the addition of some liquorice powder; that of the latter, from 1 to 1½ fl. oz. As, however, when frequently taken, these pills sometimes occasioned salivation, which proved prejudicial to their sale, a little compound extract of colocynth (*Ph. L.*, 1836) was introduced into their composition, by which this objection was obviated. Ultimately, their composition was

settled at 3 gr. of mercurial pill, and 2 gr. of compound extract of colocynth; and these proportions are still followed as the best by those who prepare and sell them. They are active remedies, and their use should not be resorted to except under professional advice.

ABERRA'TION. [Eng., Fr.] *Syn.* ABERRA'TIO, L. A wandering or deviation from the usual course, or from the normal condition. In *optics*, the deviation of the rays of light from the true focus, when inflected by a lens or speculum. This arises from a difference in the physical nature of the rays, from the figure of the lenses or specula, or from the nature of the materials of which the media traversed are composed. See ACHROMATISM, LENS, &c.

Aberration of Mind. A phrase used to express various mental states for which insanity might appear too strong a term, and which may be made to include anything from mere absent-mindedness to temporary insanity.

AB'IOGENESIS. *Syn.* GENERATIO ÆQUIVOCA, ARCHIGENESIS, ARCHEBIOSIS, Spontaneous generation. The production of living from non-living matter. The possibility of this occurring in nature has, from the very earliest times, been a matter of discussion, and in recent years, owing to the great advances made in the methods of study of the lowest forms of life, has given rise to considerable controversy, the details of which would be out of place here. The experimental proof of abiogenesis turns upon the production, in infusions which have been subjected to prolonged heating in glass vessels, and in which, presumably, all life has been destroyed, of minute organisms. The upholders of the theory assert that such has occurred under their observation, whilst their opponents, admitting the result, attribute it to imperfections in manipulation and the presence in the infusion, of the spores of the lowest organisms, derived from the air, and which are notoriously difficult to destroy. See BACTERIA.

ABLU'TION. [Eng., Fr.] *Syn.* ABLU'TIO, L. In a *general sense*, washing, cleansing, or purification by water.

Ablution. In *hygiène* and the *toilet*, a washing of the whole body, or any part of it. The value of frequent and copious affusions of pure water to the surface of the body is well known. During life, the skin is continually subjected to abrasion and the processes of reproduction and decay, by which the cuticle, its exterior portion, is being constantly thrown off as effete and useless matter, in the shape of very minute scales or dust. This, mingling with the oily and saline products of the skin, acquires sufficient adhesiveness to attach itself to the surface of the body and clothing, as well as to attract the waste particles of the dress, and the dust and soot floating in the atmosphere. In this way, if occasional ablutions be not had recourse to, the channels of perspiration will become choked, and the clothing itself rendered unwholesome and unfit for use. The consequence of the pores of the skin being obstructed is impeded transpiration, by which its functions, as a respiratory organ, are interfered with or suspended. Frequent washing, bathing, combing and brushing the hair, change of linen and clothing, prevents this accumulation on the surface of the body, and allows the skin to perform its functions freely and without hindrance, and by so doing relieves the other organs of the body from the extra strain put upon them in consequence of the inactivity of the skin, induced by the clogging of its pores with dirt. This is not, however, the only disadvantage of want of personal cleanliness. Frequent washing and exposure of the part to air, in addition to removing and destroying dirt, and possibly the germs of infectious disease accompanying it, stimulates the superficial blood-vessels of the body, increases the flow of blood to the skin, and promotes the elimination of effete matters, at the same time rendering the skin more supple, and beautiful to the eye. The inculcation of habits of personal cleanliness cannot be too forcibly emphasised. The fact, however, cannot be overlooked, that in order to introduce habits of cleanliness among the poorer classes a plentiful supply of water, combined with cheap baths, is requisite. Nothing conduces to want of cleanliness so much as the want of conveniences for ablution, and the importance of an ample supply of water to every house cannot be exaggerated. The body should be washed all over every morning with either cold or lukewarm water and soap. This custom is more necessary for workmen employed in laborious and dirty occupations than for those who live sedentary lives; but all people perspire, and from every drop of perspiration the water evaporates, and leaves a fraction of solid matter on and around the pores that excrete the perspiration. If this solid matter be not washed off, it accumulates and may derange the health. Cold ablution, that has been so indiscriminately recommended, is not half so efficacious, nor so safe, as lukewarm. The German aurists ascribe the presence of the large amount of deafness in England to our habit of washing the head and ears each morning with cold water.

Ablution. In *medicine*, the washing the body, externally, as by bathing; or internally, by diluting drinks. In ancient medicine, according to Galen, internal ablution was accomplished by the use of profuse libations of milk-whey; an object now aimed at by the hydropathists by the copious administration of pure cold water. To neglect the daily ablution of an infant is to discard one of the greatest aids to its healthy development and physical wellbeing. Water at a temperature ranging from 80°—90° F. should always be used. Mr Chavasse, in his 'Counsel to a Mother,' is emphatic in his advocacy of rain-water. He also advises the employment of castile soap, and of glycerine soap, should there be any excoriation of the skin. Of course the same remarks apply to children as to infants, with this difference, that the ablution is to be performed with water a few degrees colder; and both infants and children should be rubbed dry with a dry, soft towel. There are doubtless many persons who deem themselves cleanly washed if, in addition to their hands and arms, neck and face, undergoing duly daily ablution, they wash their feet once a week. These individuals cannot reflect that, because of their less exposure to the depurating influence of the atmosphere, the feet require to be more frequently washed than either the hands or face. See BATHING, BATHS, HYDROPATHY, &c.

ABNORM'AL. [Eng., Fr.] *Syn.* ABNOR'MIS, L. In *medicine* and the *collateral sciences*, contrary to, or without system or rule; irregular; deformed; unnatural. In a diseased or unhealthy state.

ABOMA'SUM. [Caillette, Fr.] The fourth or rennet stomach of ruminants, the analogue of the single stomach of mammals.

ABORTION IN ANIMALS. Abortion consists in the expulsion of the ovum or fœtus, before it has attained sufficient development to live apart from the mother. Abortion may be said to take place, in the Mare, if the fœtus be expelled forty days before the normal period, in the Bovine species, thirty-five days, in Sheep and Goats twenty days, in the Pig fifteen days, and in the Bitch or Cat seven days (Fleming). Bitches, Cats, and Pigs rarely abort; Sheep and Goats are somewhat liable; Cows and Mares, especially the former, being most liable to the accident.

Abortion in animals is described as *Sporadic*, when isolated cases occur over a considerable area, without obvious connection; and as *Enzoötic* or *Epizoötic*, when the animals in one farm, village, or district miscarry in large numbers.

Abortion, Sporadic Causes of. According to Fleming the most important are: exposure to cold, wet weather; bad, indigestible, or frozen food; water taken in large quantity, filthy water; certain plants, such as horse-tails (Equisetaceæ), sedges (Cyperaceæ), &c., and the leaves of beetroot. Rue, savin, ergotised grasses and grains, will often cause serious loss; excessive muscular exertion, railway travelling, and blows and shocks of all kinds, especially on the abdomen, excitement, fear, or anger, are common causes. Badly fed and neglected animals are also somewhat predisposed to abort.

Abortion, Epizootic. Epidemics of abortion are but too well known, though the cause is very obscure. There would appear to be a connection between them and wet, cold seasons, in which the forage is bad and badly won, leading to the belief that the fungi, and parasites which are freely developed under these conditions in the forage, are largely responsible for the epidemics. Epizootic abortion is often curiously local, sparing some districts and raging in others close by; whether it be due to some specific poison, or organism, is very uncertain, but the facts are difficult to explain except on some such hypothesis.

Treatment is preventive and remedial, and only the general principles of it can be given here; removal of all known causes is an obvious precaution. If abortion appear to be imminent narcotics may be given, one to two and a half drachms of laudanum, every half hour in very small enemata (not more than half a wineglassful at once); the animals should be kept very quiet, alone, and in the dark if possible, the abdomen should be gently rubbed for some time, small quantities of easily digested food or gruel given from time to time, till all danger is passed, and the stall should be kept well littered.

Epizootic abortion seems to be best treated as an infectious disorder, viz. by isolation of affected animals and their attendants, the observation of the most scrupulous cleanliness in the stables and cowhouses, removal and destruction of all excreta and fouled bedding. The stalls should not be occupied by healthy animals until they have been thoroughly cleansed and disinfected and exposed to light and air for many days. Animals which have aborted or show symptoms of abortion should at once be removed from contact with others which are pregnant. Animals which have once aborted, especially cows, have a tendency to abort again; the period of gestation after each abortion is however usually longer, and cows will reach their full period at about the third pregnancy after an abortion.

ABRACADABRA. A word of unknown origin. It occurs first in a poem by Q. Severus Sammonicus. It was a cabalistic word, used as a charm, and believed to have the power, when written in a triangular arrangement and worn round the neck, to cure agues. T. A. G. Balfour (1860) has pointed out that the combination 'abra,' which is twice repeated in this word, is composed of the initials of the four Hebrew words *Ab, Ben, Ruach, Acadosch*, signifying Father, Son, and Holy Spirit.

ABRA'SION. [Eng., Fr.] *Syn.* ABRA'SIO, L. The rubbing or wearing down of surfaces by friction. In the *arts*, the reduction or figuration of materials by the use of an abrasive tool, or grinder, of which the effective portion is an exact counterpart of the form to be produced.

Abrasion. In *numismatics*, the 'wear and tear,' or waste of the substance of coins, in the pocket and circulation. It forms a large item in the expense of a metallic currency. The means employed to obviate, or to reduce it, consist in either alloying the metal to render it tougher and harder, or raising the borders so as to lessen the surface exposed to friction. In well-formed coin both methods are adopted.

Abrasion. In *pathology* and *surgery*, a superficial removal or injury of the skin by fretting or friction.

Treat., &c. Careful cleansing and the application of some simple ointment or carbolised oil. If the injured surface be large or exposed, it is well to protect it from dirt and from further injury by a piece of lint kept in place by a bandage. See EXCORIATIONS.

ABRUS PRECATORIUS. Indian Liquorice Plant. Indigenous to India, now found in all tropical countries. The root has been used in place of liquorice, but is considered a bad substitute.

Abrus Seeds, Jequirity Seeds. The seeds of the above plant are used for necklaces and other ornamental purposes; also in India as a standard of weight under the name of 'retti' (= $2\frac{3}{16}$ grains) by Hindu jewellers and druggists. They are the size of a small pea, with a fine polish, prettily coloured black and red. The seeds are poisonous; they contain abric acid, oil, and some albuminoids. Dr S. Martin obtained from them a globulin and an albuminose, which he classes with similar bodies occurring in papaw juice and the venom of snakes.

Action. An infusion applied to the eye causes inflammation of the conjunctiva, and is used to produce purulent ophthalmia in order to cure granular lids.

Infusion of Abrus Seeds. Abrus seeds in powder three parts, cold water 500 parts; mix, then

add hot water 500 parts. Filter when cold. It may be applied three times a day.

ABSCESS.—A collection of pus, the result of inflammation, and which may occur in any part of the body. Abscesses are said to be *circumscribed* if the material which collects is limited by changes in the parts around. When this is not the case, but the process spreads and by degrees involves the surrounding tissue, the abscess is said to be *diffused.* An abscess is said to be *acute,* when the contents rapidly liquefy, *chronic* or *cold,* when this process is slow. Abscesses always proceed in the direction of the least resistance, and when superficial make their way through the skin, forming a conical projection, the top of which ultimately gives way and allows the contents to discharge freely. Something may be done to direct the course of superficial abscesses by the judicious application of poultices and hot fomentations, which by increasing the inflammation at a particular point, tend to prevent its spread to the parts around. Abscesses on the face connected with decayed teeth may by injudicious external poulticing be made to point externally, and cause a disfiguring scar, whereas by proper treatment, a small bread poultice within the mouth, extraction of the tooth, or use of the lancet, they can be made to break internally. The causes of acute abscesses are various; a blow or pressure is often sufficient in the case of persons weakened by long illness; foreign bodies such as splinters of wood, broken needles, and the various things which may be introduced into a wound from without, are apt to cause abscesses by setting up local inflammation, whilst diseased bone (as in hip disease) and the stumps of decayed teeth, acting in the same way, bring about the same result from within; in these cases the remedy is removal of the cause of irritation, and this may be done either by operation (removal of diseased bone, extraction of teeth, &c.), or by allowing nature to have her way and expel the offending material by a process of suppuration, at the expense of considerable suffering and discomfort and the risk of extensive local injury. Abscesses also break out in various parts of the body as the result of blood-poisoning, and in various so-called septic disorders.

Treatment.—Rest and soothing local applications; the abscess should be opened as soon as the presence of pus is recognised, this relieves the pain caused by the tension of the parts, and avoids the scar which would be left if the inflammation were allowed to run its course. The wound should be wrapped in simple antiseptic dressings, *e. g.* carbolised, or boracic lint, frequently changed, and kept as clean as possible by washing with boiled water. Extensive abscesses, or a number of small ones, greatly affect the general health, and in these cases rest, fresh air, simple food and tonics are indicated.

ABSINTHE. [Fr.] ABSINTHIUM, L.; WORMWOOD, E.; WERMUTH, G. This article is met with in commerce in the form of the dried herb with the flowers of *Artemisia absinthium,* having a whitish-grey appearance, a soft feel, an aromatic and unpleasant odour, and an extremely bitter and aromatic flavour. The plant is indigenous, and grows in thickets, in mountainous districts, and on waste ground. Its odour is due to its containing an essential oil; its bitterness is referable to *absinthin,* a crystallisable principle which may be extracted from the herb by water or spirit. The name *absinthe* is also given to an intoxicating liqueur which is extensively drunk on the Continent.

Absinthe is prepared by pounding the leaves and flowering tops of various species of wormwood, chiefly *Artemisia absinthium* along with Angelica root (*Archangelica officinalis*), Sweet Flag root (*Acorus calamus*), the leaves of Dittany of Crete (*Origanum dictamnus*), Star Anise fruit (*Illicium anisatum*), and other aromatics and macerating them in alcohol. After soaking for about eight days the compound is distilled, yielding an emerald-coloured liquor to which a proportion of an essential oil—usually Anise—is added, the result is 'Extrait d'Absinthe.' Adulterations are numerous and deleterious, turmeric and indigo for colour, or even cupric sulphate.

As at present constituted, therefore, and especially when drunk in the disastrous excess now common in Paris, and taken, as it frequently is, on an empty stomach, absinthe forms a chronic poison of almost unequalled virulence, both as an irritant to the stomach and bowels, and also as a destroyer of the nervous system. The effect of absinthe is to produce a superabundant activity of the brain, a cerebral excitement, which at first is agreeable; intoxication comes on rapidly; the head swims, and the effect produced is nearly the same as that of poisoning by a narcotic, which certainly does not occur with an equal dose of brandy. The effects may be summed up as follows:

Results of excessive drinking.—Firstly a feeling of exaltation, afterwards the increased dose necessary to produce this effect causes derangement of the digestion and loss of appetite with intense thirst, then giddiness, tingling in the ears, hallucinations of sight and hearing, followed by constant mental depression and anxiety.

Constant drinking.—Produces muscular quiverings, and loss of strength and also of hair, melancholy aspect, emaciation, wrinkled and sallow skin, lesions of the brain, paralysis and death.

With the absinthe-drinker, as with the opium-eater, the excitement the spirit produces diminishes daily in intensity. Each day he is obliged to augment the dose in order to bring himself up to the right pitch. The diseases brought on by the excessive drinking of ardent spirits are produced with greater rapidity by the use of absinthe. Absinthe was introduced into France after the Algerian war of 1844-47 in which the soldiers were advised to mix it with water as a febrifuge. See LIQUEURS.

ABSINTHIN. $C_{16}H_{22}O_5$. The bitter principle of wormwood (*Artemisia absinthium*). A hard crystalline solid, having an intensely bitter taste; slightly soluble in water, very soluble in alcohol, less so in ether. Its physiological effects resemble those of extract of wormwood.—*Dose,* $\frac{1}{2}$ gr. to 2 gr., or more; in dyspepsia; as a stomachic, to promote the appetite, &c.; as a substitute for quinine in intermittents; and in worms.

ABSINTH'IUM. [L.] See ABSINTHE.

ABSOLUTE. *Syns.* ABSOLUTUS, L.; ABSOLU, Fr.; UNBEDINGT, G. In *chemistry,* pure, unmixed; as *absolute alcohol,* pure spirit of wine, *i. e.* free from water.

ABSORBED′ (-sorbd′). *Syn.* CHILLED; ABSORBÉ, Fr. In *painting*, a term among French connoisseurs, to represent that state of a picture in which the oil has sunk into the canvas or ground, leaving the colours 'flat,' and the touches indistinct. The remedy consists in rubbing the surface of the picture, previously well cleaned, with a soft sponge dipped in a little drying oil, and after some days varnishing it; when it should be kept in a warm room until perfectly dry.

ABSORB′ENT. *Syn.* ABSORB′ENS, L.; ABSORBANT, Fr.; ABSORBIREND, Ger. Imbibing; that imbibes or sucks up; variously applied in science and art. (See *below*.)

Absorbent Ground. In *painting*, a picture-ground prepared wholly or chiefly in distemper or water colour, in order that the redundant oil in the colours subsequently applied may be immediately 'absorbed,' by which expedition is permitted, and brilliancy imparted to them.

Absorbent Powders. Fine powders used locally for drying purposes or to allay irritation, sometimes to hide unsightly patches, as in skin diseases, or to give an artificial softness to the skin in form of toilet powder. The most useful absorbents are kaolin, Fuller's earth, French chalk, starch, oxide of zinc, calamina, oxychloride of bismuth, and oat flour. Mixtures of these are perfumed and sold under fancy names. A drying powder much used in hospitals is a mixture of 1 part zinc oxide and 2 parts starch powder.

Absorbent Surfaces. In the *arts*, these are usually rendered non-absorbent, preliminary to their being bronzed, gilded, painted, or varnished, by giving them one, or more, coats of thin size, so as to destroy their porosity; care being taken to allow each coat to become thoroughly dry before the application of the next one; and also, finally, to remove any unabsorbed excess of size from the surface, by means of a sponge dipped in warm water. This applies to ALABASTER, PAPER, WOOD, PLASTER CASTS, &c.; and to WALLS and CEILINGS which are not exposed to the weather, and which there is not time to prepare with drying oil. See BRONZING, MAPS, VARNISHING, &c.

Absorption and consequent adherence in porous moulds, as those of plaster, are usually prevented by thoroughly saturating the pores of the mould with melted tallow, or a mixture of tallow and bees' wax; or for delicate objects or the electrotype, with white wax. The 'dry moulds' are either heated before the application of these substances, or they are boiled in them; any portion that may finally remain unabsorbed being carefully removed with cotton-wool or a soft rag. Another method is to wash the moulds over two or three times with drying oil, or to boil them in in it; after which they must be exposed to the air for some days, to dry and harden. Before being used for plaster, composition, &c., the surface of these prepared moulds require to be slightly moistened with sweet oil.

Plaster moulds are generally prepared for sulphur, wax, and gutta-percha casts, by simply placing them (upright) with the back immersed in a little water, contained in any shallow vessel, as a saucer or plate; and letting them remain there until moisture begins to appear on the surface. The materials to be cast, or moulded, should then be used at the lowest possible temperature, to prevent the formation of air-bubbles.

The adherence of wax, or mixtures containing it, and of gutta percha, is best prevented by moistening the surface of the mould (whether of plaster, metal, or gutta percha), immediately before use, with soft soap reduced to the consistence of thin cream with water. See CASTS, MOULDS, ELECTROTYPE, &c.

ABSORBENTS. The lymphatic or absorbent vessels, so called from their reputed function, are distinct from the blood-vessels and arise in almost every part of the body, ultimately entering the great veins of the neck. The majority previously oin into a main trunk, the thoracic duct, which lies in front of the vertebræ, and opens into the veins of the left side at the angle of junction of the subclavian and internal jugular veins. The absorbents of the alimentary canal during digestion carry a milky opaque fluid, the "chyle," which they absorb from the food, hence their special name "lacteals."

Absorbents. In *botany* and *vegetable physiology*, the origins of the different vessels constituting the vascular tissue, as they are found in the root, where they imbibe or suck up the nutritive fluids from the soil. See PLANTS and VEGETABLES.

Absorbents. In *agriculture* and *chemistry*, substances which possess the power of withdrawing moisture from the atmosphere; as soils, calcium chloride, strong sulphuric acid, argillaceous earths, &c. Also (but less frequently) substances which neutralise acids; as chalk, lime, and magnesia. Absorbents differ from 'deliquescent salts'; the latter attract moisture and dissolve in it; whilst the former merely suck it into their pores, as a sponge does water. See ABSORPTION.

Absorbents. *Syn.* ABSORBEN′TIA, L. In *medicine* and *pharmacy*, substances which remove acidity from the stomach and bowels. Of these the principal are—magnesia, carbonate and bicorbonate of magnesia, prepared chalk, and the carbonates and bicarbonates of potash, soda, and ammonia. The first four are popularly called earthy absorbents; and the others, alkaline absorbents. See ANTACIDS.

Absorbents. In *surgery*, cotton deprived of its oil, lint, tow, wood wool, moss, and peat.

The following absorbent mixtures are taken from Dr Kirby's valuable work, 'Selected Remedies':

1. Infusion of rhubarb, 1½ oz.; compound spirit of ammonia, 1½ dr.; compound infusion of gentian to 6 oz. Two tablespoonfuls to be taken 3 times a day.

2. Bicarbonate of potash, 1½ dr.; syrup, 2 dr.; compound spirit of ammonia, 1½ dr.; compound infusion of gentian to 6 oz. Two tablespoonfuls to be taken 3 times a day.

3. Bicarbonate of soda, 1½ dr.; spirits of chloroform, 1½ dr.; infusion of calumba to 6 oz. Two tablespoonfuls to be taken 3 times a day.

ABSORP′TION. [Eng., Fr.] *Syn.* ABSORP′TIO, L.; EINSAUGUNG, Ger. The act or the power of absorbing, in various applications. (See *below*.)

Absorption. In *agriculture*, the power possessed by soils of absorbing moisture from the atmosphere. The more a soil is divided by labour and vegetation, the greater is its absorbent power, and, consequently, its fertility. Indeed, the latter

chiefly depends on its capacity for imbibing moisture, and may be illustrated by the difference between recent and disintegrated lava. (*Leslie.*) The finely divided state, most penetrable by the delicate fibres of plants, appears to derive its superior power of acting on atmospheric vapour from the augmentation of its surface and the multiplication of its points of contact. (*Ure.*) This method of increasing the fertility of a soil is well known to scientific farmers, and seldom neglected by them. (*Loudon.*) That soil must be regarded as the most fertile which possesses this power in the greatest degree. Garden-mould has the highest absorbent power of any mineral substance. (*Leslie.*)

Method of determining the ABSORBING POWER OF A SOIL. Take a known weight of the soil, carefully sampled (about 1 oz.), spread it on paper, and expose it to the air of a dry room till it ceases to lose weight; the difference indicates water lost by evaporation. Place the sample thus air dried in a small beaker, and heat in an oil bath to 150°—160° C. (300°—350° Fahr.) until it ceases to lose weight—observe the amount of loss. Now expose the soil so dried to the air on a sheet of paper for twenty-four hours—weigh again. The gain in weight is due to water absorbed; if this amount to 1 part in 50 of soil it is so far an indication of great agricultural capability. (*Sutton.*) See under SOILS.

Absorption. In *chemistry,* the passage of gases and vapours into liquid and solid substances. Thus, water absorbs the oxygen of the air, lime absorbs water, charcoal absorbs ammoniacal and other gases.

Absorption. In *medicine* and *toxicology,* see MEDICINES and POISONS.

Absorption. In *perfumery,* see ENFLEURAGE.

Absorption. In *physics,* see HEAT, LIGHT, REFRIGERATION, &c.

Absorption. In *physiology* (animal and vegetable) the function of sucking, or taking up, of appropriate substances, by the 'absorbent vessels.' It is one of the chief vital functions, the primary object of which is to convey to the circulatory organs the proper supply of the materials necessary for the support and growth of the body; and subsequently, to remove and convey to these organs its effete and useless portions, in order to their ultimate elimination from the system.

Absorption. In *surgery,* the natural process by which tumours and their contents, morbid growths, and, sometimes, even healthy glands, &c., are gradually taken up and disappear, by the action of the 'absorbents.'

Absorption (of Surfaces, Moulds, &c.). See ABSORBENT SURFACES.

ABSTERGENTS. See DETERGENTS.

ABSTRACTS. ABSTRACTA, L. Solid powdered preparations, containing the soluble constituents of the drugs from which they are made; and bearing a definite and uniform relation to the drug from which they are made. They are prepared by evaporating a tincture of the drug at a low temperature, mixing with dry sugar of milk, so as to make the final product when dry weigh half the weight of the drug. They were first introduced into the United States Pharmacopœia of 1880.

ACAJOU NUT. *Syn.* CASHEW NUT. The fruit of *Anacardium occidentale,* a native of the West Indies, is kidney shaped, about an inch in length, and has a double shell. The kernel is oily, and is used as a common article of food in the tropics.

ACANTH'OCEPHALA. The second natural order into which the Nemathelminthes or round worms are divided. Parasitic worms, represented by the large thorn-headed worm (*Echinorhynchus gigas*), occasionally found in the pig in England, common in France and Germany, and also in some parts of the United States.

The male is generally about four inches in length, the female fifteen to twenty-four inches. This worm perforates the intestines of the hog, causing serious lesions, and ultimately death. According to Schneider, the eggs are discharged in the dung of the pig, eaten by maggots, in whose intestines the worm is developed; the maggots are eaten by the pigs, and the Echinorhynchus again reaches sexual maturity, and produces ova. See WORMS AND PARASITES.

AC'ARI (-rī). [L.; prim. Gr.] *Syn.* ACAR'IDANS; ACAR'IDES (dēz); ACARID'IÆ (-e-ē). In *entomology,* a division of Arachnidans, including the *mite* and *tick.* All the species are either microscopic or extremely minute, and possess such tenacity of life as to resist for some time the action of boiling water, and to live with comparative impunity in alcohol. Leuwenhoek had one that lived eleven weeks glued on its back to the point of a needle without food. The following are well known—ACARUS AUTUMNA'LIS, the *harvest-bug* or *wheal-worm;* A. DOMES'TICUS, the *domestic tick;* A. DYSENTE'RIÆ, the *dysentery-tick;* A. FARI'NÆ, the *meal-mite* (fig. *a*); A. RI''CINUS

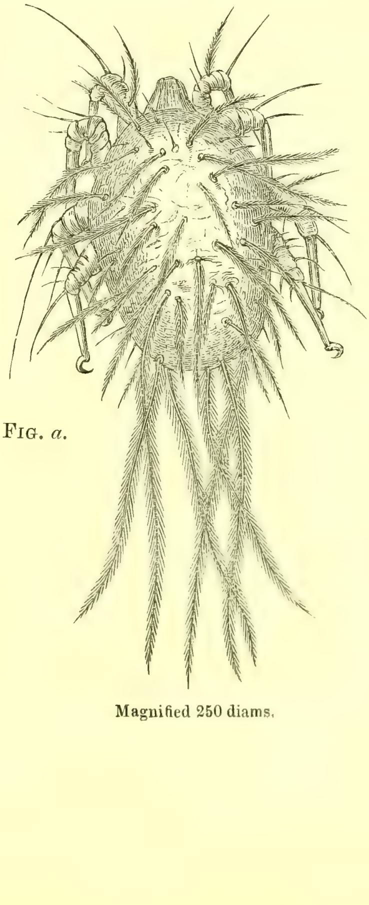


FIG. *a.*

Magnified 250 diams.

(rĭc-), the *dog-tick;* A. SAC'CHARI, the *sugar-mite* (fig. *b*); A. SI''RO, the *cheese-mite* (fig. *c*); A. SCABIE'I, the *itch-insect* (fig. *d*). See ITCH, MANGE, PARASITES, PEDICULI, SCAB, &c.

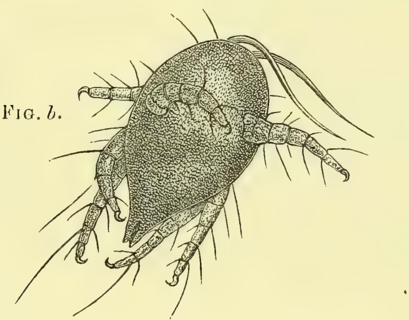
Acarus Farinæ, or *meal-mite* (fig. *a*). This insect is found only in damaged flour, and is more frequently met with in the flour of the *leguminosæ* (beans, peas) than in that of the *gramineæ* (wheat, rye, oat).

Now and then a single acarus may occasionally be found in good flour, but even one should be regarded with suspicion, and the flour should afterwards be frequently examined to see if they are increasing.

Acarus Folliculorum, or more properly **Steatozoon Folliculorum**, is a very minute parasite commonly found in the sebaceous and hair follicles of the face; it is of little importance, and its presence does not indicate disease. See LICE.

Acarus Sacchari, or *sugar-mite* (fig. *b*). Most of the brown sugars of commerce are infested by this pest, which is of a size sufficiently large

FIG. *b*.



Magnified 260 diams.

to be visible to the naked eye. The following method of proceeding will lead to its detection.

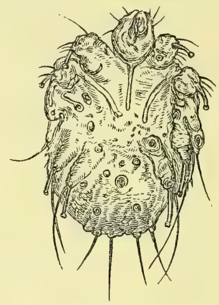
Dissolve 2 or 3 teaspoonfuls of sugar in a large wineglass of tepid water, and let the solution remain for an hour or so, at the expiration of which time the acari may be found, some on the surface of the liquid, some attaching themselves to the sides of the glass, and some at the bottom, mixed up with the copious and dark sediment, made up of fragments of cane, woody fibre, grit, dirt, and starch granules, which usually subside on dissolving even a small quantity of sugar in hot water. When first hatched this acarus is hardly visible.

Acari of all sizes—that is, in all stages of growth—may be met with in most samples of sugar.

Dr Hassall, in seventy-two samples of sugar which he examined, found sixty-nine containing them.

Acarus Siro, the *cheese-mite* (fig. *c*). The dry and powdery parts of decayed cheese, which by careful watching may very frequently be seen in movement, consist almost wholly of this insect and their eggs in different stages of development. The cheese-mite can hardly be seen without the aid of the microscope. They are very tenacious of life, even when kept without food. Mr Blyth says that under these circumstances "it is no uncommon sight to see them killing and devouring each other; and that cheese is rapidly destroyed by them; they crumble it into

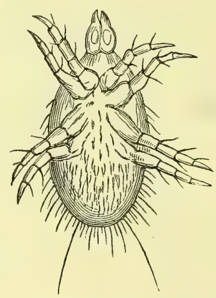
FIG. *c*.



minute pieces, and emit a liquid substance, which causes the decayed parts to spread speedily." They may be destroyed by being exposed to a strong heat, or by putting the cheese for a short time in whisky.

Acarus Scabiei, or Sarcoptes Hominis, the *itch-insect* (fig. *d*). The parasitic character of

FIG. *d*.



the disease known as the itch was first demonstrated by Dr Bononio, who on turning out the contents of one of the little bladders that show themselves between the fingers of those affected with the complaint, and placing the fluid under the microscope, discovered a minute animal, very nimble in its movements, covered with short hairs, having a short head, a pair of strong mandibles or cutting-jaws, and eight legs, terminating in remarkable appendages, each provided with a sucker and setæ.

It has no eyes; but when disturbed it quickly draws in its head and feet, and then somewhat resembles the tortoise in appearance, its march being precisely the same. It usually lays ten to fifteen eggs, which are carefully deposited in furrows under the skin, and ranged in pairs; these are hatched in about ten days to a fortnight.

"To find the itch-insect," says Mr Jabez Hogg, "the operator must carefully examine the parts surrounding each pustule; he will then see a red line or spot communicating with it; this part, and not the pustule, must be probed with a fine-pointed instrument. The operator must not be disappointed by repeated failures."

ACCIDENTS. First aid to the injured is often a matter of the most urgent importance, as a very small amount of knowledge of what to do

in cases of accident, and still more a knowledge of what *not* to do, may be the means of saving a very large amount of suffering and even life. It is beyond the scope of this work to enter into the details of treatment, but under the separate heads, will be found a brief epitome of the instructions usually given to 'Ambulance Classes' for the immediate treatment of the more common injuries and accidents. See BURNS, BITES, BLEEDING, CHOKING, COLLAPSE, DISLOCATIONS, DROWNING, DRUNKENNESS, EAR, EYE, EPILEPSY, FAINTING, FRACTURE, FIRE, HANGING, INSENSIBILITY, MINES, NARCOTICS, NOSE, PARALYSIS, POISONING, RESCUE, SPRAINS, STINGS, SUNSTROKE, TEMPERATURE, TOURNIQUET.

ACCLI'MATE, or ACCLI'MATISE. In *botany* and *zoology*, to inure a plant or animal to a climate to which it is not indigenous. When so inured it is said to be ACCLIMATED. In *medicine*, to habituate the body to a foreign climate, so that it may not be peculiarly liable to its endemic diseases; or to become so habituated. Thus, a person who has resided several years at New Orleans without an attack of yellow fever, or having had an attack has satisfactorily recovered, is said to be ACCLI'MATISED.

ACCOM'PANIMENTS. In *cookery* and *housekeeping*, see TRIMMINGS.

ACCOUNT-BOOKS, SIZES OF. See PAPER.

ACCUMULA'TION. [Eng., Fr.] *Syn.* ACCUMULA'TIO, L. In *medicine*, a term applied when the effects of the first dose of any substance still continue when the second is administered (accumulation of action); or when several doses of insoluble substances remain inactive in the system until their energy is developed by chemical influence (accumulation of doses). See MEDICINES, POISONS, &c.

ACCUMULATOR. See ELECTRIC LIGHT.

A. C. E. A mixture used as an anæsthetic and approved by a committee of the Royal Medical and Chirurgical Society. Where deep and prolonged anæsthesia is required it is considered to be safer and quite as effective as chloroform. Especially useful in cases of midwifery. The formula is as follows:—Absolute alcohol one volume, chloroform two volumes, pure ether three volumes.

ACEPHALA. The Mollusca are sometimes divided into Encephala and Acephala, according as they have, or have not, a distinctly differentiated head. The Acephala comprise the bivalve shellfish, or Lamellibranchiata, as they are commonly called.

ACERB'ITY. *Syn.* ACERB'ITAS, L.; ACERBITÉ, Fr.; HERBIGKEIT, Ger. In *chemistry*, &c., sourness, with bitterness and astringency, or harshness. See CIDER, FRUIT, WINE, &c.

ACES'CENT. *Syns.* ACES'CENS, L.; ACESCENT, AIGRELET, Fr.; SÄURLICH, Ger. In *chemistry*, &c., growing sour; slightly tart or acid; having a tendency to sourness, or to run into the acetic fermentation, as *wine, beer, maltwort*, &c. Hence, ACES'CENCE or ACES'CENCY (*acescen'tia*, L.; *acescense, aigreur*, Fr.; *säurlichkeit*, Ger.), the tendency to become slightly acid, or the quality of being so. See ACETIFICATION, MALT-LIQUORS, WINE, WORT, &c.

ACETANILIDE. See ANTIFEBRIN.

AC'ETATE. *Syn.* AC'ETAS, L.; ACETATE, Fr.; ESSIGSÄURE SALZE, Ger. A salt of acetic acid. The word, as commonly used, refers to metallic salts, such as potassium acetate, $KC_2H_3O_2$, and lead acetate, $Pb(C_2H_3O_2)_2$; but it also applies, of course, to salts of organic bases, *e.g.* morphine acetate, $C_{17}H_{19}NO_3.C_2H_4O_2$, and to acetic ethers, *e.g.* ethylic acetate, $C_2H_5O.C_2H_3O$.

Preparation. See under ACETIC ACID and the respective metals. Speaking generally, they may all be prepared by direct solution of the oxide, hydroxide or carbonate of the metal in dilute acetic acid, or, in some cases, from another acetate by double decomposition.

Properties, &c. All the normal acetates are more or less soluble in water, some of them being very deliquescent, and many are also soluble in alcohol. They are all decomposed upon heating, most of them yielding carbon dioxide, acetone and an empyreumatic oil, and those with weak bases giving off a portion of their acid as such; at a full red heat the acetates of potassium, sodium, barium, strontium, calcium, and magnesium are converted into carbonates; whilst the other metallic acetates leave behind the oxide or metal. The aqueous solutions of the alkaline acetates soon turn mouldy, and suffer decomposition. No more of them should therefore be dissolved at once than is required for immediate use.

Tests for (also applicable in the case of acetic acid). The acetates are recognised:

(*a*) By their giving off the vapour of acetic acid, recognisable by its peculiar and pungent odour, on the addition of moderately strong sulphuric acid.

(*b*) By their evolving the pleasant-smelling acetic ether when gently warmed with a mixture of about equal parts of concentrated sulphuric acid and spirits of wine.

(*c*) When metallic acetates are subjected to dry distillation, acetone, $(CH_3)_2CO$, is given off, and can be recognised at once by its characteristic odour.

(*d*) When ferric chloride, Fe_2Cl_6, is added to a neutral acetate, the liquid acquires a deep red colour owing to the formation of ferric acetate. On boiling (if the acetate is in excess), the whole of the ferric salt present is precipitated as basic ferric acetate. The cold red liquid is not decolourised on the addition of mercuric chloride, $HgCl_2$, and is not taken up by ether on agitation with the latter (difference from thiocyanates), but it is readily destroyed on the addition of cold dilute sulphuric or hydrochloric acid (difference from meconates). In applying this test to acetate of lead (from which ferric chloride would precipitate lead chloride, $PbCl_2$), or to insoluble basic acetates generally, the latter should first be converted into acetate of soda by digesting them with sodic carbonate and filtering. Should the filtrate now be alkaline from excess of carbonate of soda, it must be neutralised by hydrochloric acid before adding the ferric chloride.

ACETIC ACID. $H(C_2H_3O_2)$. *Syn.* ACIDUM ACÉTICUM, L.; ACIDE ACETIQUE, Fr.; ACIDO ACÉTICO, It.; ESSIGSÄURE, Ger.

M. Pt. 16·5° C. (61·7° F.); B. Pt. 118·3° C. (233° F.); Sp. gr. at 0° C., 1·0701.

Occurrence. Acetic acid occurs in the juices of

many plants, especially of trees, and in certain animal secretions.

Prep. It is prepared:

1. By the oxidation of alcohol:

(*a*) In the form of vinegar by the acetic fermentation of liquids containing alcohol, such as wine, beer, &c.

(*b*) As the more or less pure dilute acid, through the agency of platinum black. This method, however, can hardly be called a technical one, as the apparatus required is expensive, and the loss of alcohol by evaporation very considerable. It need not, therefore, be described here further than by saying that the vapour from dilute (not strong) spirits of wine, contained in a series of small shallow vessels, is allowed to pass over platinum black, placed in watch-glasses, one of which is supported over each vessel containing the alcohol. The whole series is arranged in a glass case, and kept at a temperature of 21°—32° C. (70°—90° Fahr.), in sunshine, if possible, care being taken to regulate the access of air properly. The finely divided platinum promotes the oxidation of the alcohol (C_2H_6O) to acetic acid ($C_2H_4O_2$).

2. As pyroligneous acid, by the destructive distillation of wood.

The articles upon (1) *Vinegar*, (2) *Pyroligneous acid*, and (4) *Acetates*, must be read in the order named in conjunction with this one (3); which will be restricted to the preparation, &c., of acetic acid, either 'glacial' or in aqueous solution.

The following are the chief processes at present adopted for the obtaining of the acid:

I. From the *Acetates* in the moist way:

a. From ACETATE OF SODA:

1. Commercial acetate of soda (*i.e.* the 'pure acetate' of the pyroligneous acid works) is placed in a stout copper still (or in vessels such as are described below), and, a deep cavity having been made in the centre of the mass, about 35% of sulphuric acid of a sp. gr. not less than 1·84 is poured in. The whole is then thoroughly and quickly mixed with a large wooden spatula, the head of the still luted on, and the distillation conducted at a gentle heat, the receiver being changed as soon as the distillate begins to acquire a slight empyreumatic odour. The product, when the process is well managed, is an almost colourless acid of fully 1·05 sp. gr., and containing about 40% of pure acid. Any trace of colour or empyreuma is removed by agitation with some well-washed and recently ignited wood charcoal, or with a very small quantity of freshly ignited animal charcoal, and subsequent filtration through a calico bag filter; or, by allowing it to stand for a fortnight in barrels containing some beechwood chips; or also by rectification with 2% to 3% of bichromate of potash, peroxide of manganese, or red oxide of lead. A little acetic ether is added by some manufacturers to impart to the acid a pleasant aroma. After this it is ready for sale, either as the ordinary acetic acid or pure pyroligneous acid of commerce, or, after dilution, &c., as vinegar. In this process shallow vessels of wood or of copper, which are made without rivets or solder (unless it be silver solder) in those parts exposed to the action of the acid, are generally employed. A coil of drawn copper pipe, heated by steam at a pressure of 30 to 40 lbs. to the inch, traverses the bottom of the vessel and supplies the necessary heat. The refrigerator and adapter are made of well-cooled earthenware, Berlin ware, or glass. Another common form, which is even more convenient, is a stout copper still furnished with a strong iron jacket to hold high-pressure steam. Occasionally the space between the still and the jacket is filled with sand, oil, tallow, or fusible metal, in which case the apparatus is set in brickwork and heated by a naked fire. Earthenware stills are also frequently used; sometimes also worms and condensers of silver or silvered copper, the latter with great advantage. With a leaden worm the product is always contaminated by lead. A lute (if any) made of linseed meal and water, with or without a little plaster of Paris, may be employed, but flat bands and short tubes of vulcanised india rubber are much more efficient.

In the preparation of pure acid, care should be taken that the acetate of soda does not contain common salt (derived from the carbonate used in manufacturing the acetate), as the latter thus yields hydrochloric acid during the distillation. Crystallised acetate of soda, $NaC_2H_3O_2 + 3H_2O$, which loses two fifths of its weight by thorough drying, may be safely dried at a temperature of 205°—232° C. (400°—450° F.), provided care be taken to prevent ignition through sparks. A lower temperature is, however, quite sufficient to drive off the whole of its water of crystallisation. It is known to be free from water by its assuming the appearance of an oily liquid when hot; if, on heating, it emits fumes, it is suffering decomposition.

The sulphate of soda obtained as a bye product is returned to the pyroligneous acid manufacturer, who employs it to decompose fresh acetate of lime.

Glacial acetic acid (*i.e.* the pure compound $C_2H_4O_2$), which is crystalline below 16·5° C. (61·7° F.), is got from the above acid of 1·05 sp. gr. by distilling it with fused chloride of calcium. The distillate is run into a refrigerator, and the crystals thus formed are drained at a temperature not exceeding 4°—7° C. (40°—45° F.), after which they are removed to a warmer place, to liquefy them; the liquid is then agitated with a little peroxide of lead and redistilled, this process being repeated until the whole of the acid crystallises at 10·5° C. (51° F.). The product is the glacial acetic acid of commerce. The above are the processes usually adopted on the large scale in this country.

According to *Melsens*, pure glacial acetic acid is best obtained by distilling pure and dry acetate of potash with an excess of fairly pure strong acetic acid, rejecting the first portion of the distillate.

2. *M. Mollerat's* process—without distillation. Pure commercial acetate of soda, in coarse powder, is placed in a hard glazed stoneware or glass pan or receiver set in a cool situation, and 35% to 36% of sulphuric acid (of 1·843 sp. gr.) added, in such a manner that the acid may flow under the powder, and little heat be generated by the operation. The whole is then allowed to stand covered for some hours, when crystals of sulphate of soda are found to have separated on the bottom and

sides of the vessel, acetic acid—partly liquid and partly in crystals—filling the upper part. The temperature being now raised to a point high enough to liquefy the crystals of acetic acid (*i. e.* to 17°—18° C., or 62°—65° F.), the fluid is poured off, and a small quantity of pure acetate of lime added to it gradually, until it ceases to yield any trace of free sulphuric acid on evaporation. After sufficient repose it is decanted for use. An excellent commercial strong acetic acid is thus obtained without distillation, from which a strong and perfectly pure acid may be prepared by rectification, and glacial acid by refrigeration. If, however, the process be badly managed, or if the due proportions of the ingredients be not carefully observed, the product will be contaminated either with sulphuric acid or with salts. It is also important to the success of this process that it be carried out in well-cooled vessels in a cool apartment. The above plan of superseding a troublesome distillation is one of the greatest improvements yet introduced in the manufacture of acetic acid.

3. *Liebig's* process. This is essentially the same as process No. 1, but for operations on a smaller scale. 3 parts of pure acetate of soda, thoroughly dried and finely powdered, are placed in a capacious retort or flask, connected with a *Liebig's* condenser in the usual way, and 9·7 parts of pure concentrated sulphuric acid are poured over them. The heat developed by the mixing suffices to drive over one eighth of the acetic acid. Heat is next cautiously applied, either a sand-bath or low gas flame being used, and continued until the contents of the retort become quite liquid. The distillate consists of 2 parts of very pure acid, containing only 20% of water, from which glacial acid may be got as above. If a flask be used instead of a retort, there will be less danger of any sulphuric acid spirting over into the receiver. The excess of the latter acid remaining in the retort may either be recovered by distillation, or the whole residue may be used for decomposing a fresh quantity of acetate.

b. From ACETATE OF POTASH:

The salt, fused and powdered, is mixed with 50% of oil of vitriol, and the mixture distilled as above.

c. From ACETATE OF LEAD:

1. 4 parts dried acetate are distilled with 1 part oil of vitriol.

2. (*Dollfuss'* Concentrated Acetic Acid.) 12 oz. dry acetate of lead are distilled with 6 oz. sulphuric acid; the distillate amounts to 7 oz.

d. From ACETATE OF LIME:

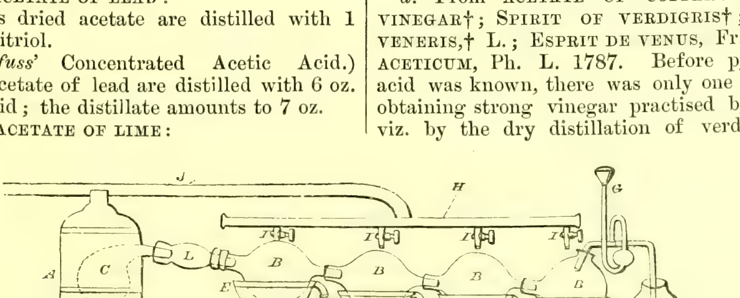
1. By mixing and distilling it in a copper vessel with hydrochloric acid of 1·15 to 1·16 sp. gr. The proportion of acid to be taken must obviously depend on the composition of the acetate, in which the amounts of lime, present as oxide or carbonate, and acetate, $Ca(C_2H_3O_2)_2$, must previously be determined. To take an example: Should the acetate contain 60% to 70% $Ca(C_2H_3O_2)_2$, 100 parts of it are taken for 90 to 95 parts of hydrochloric acid, of 1·16 sp. gr., and 25 parts of water (*Völckel*). When the proper proportions are used, the distillate gives a scarcely perceptible cloud (of silver chloride) when tested with nitrate of silver solution. Any resin found floating on the mixed ingredients should be carefully skimmed off before distillation. The product, whose strength of course varies with that of the hydrochloric acid employed, is only slightly coloured and empyreumatic, and is fit for various manufacturing purposes. When dilute hydrochloric acid is used, the distillation is very regular and the temperature does not rise above 100°—120° C. (212°—248° F.), whereby the danger of contamination with other products from the acetate of lime is much lessened.

2. An important improvement in the production of acetic acid from acetate of lime consists in the addition of chloride of calcium to the latter in quantity sufficient to form the crystalline compound, $CaCl_2, Ca(C_2H_3O_2)_2 + 10H_2O$. The mixed solutions are evaporated repeatedly to a density of 1·246 (30° Baumé), and the crystals removed each time. By this method white crystals of the above compound may be prepared from brown, or even black, acetate of lime. These are then purified by treatment with animal charcoal and recrystallisation, and finally distilled with hydrochloric acid.

3. An acid sufficiently strong and pure for many ordinary purposes may be obtained without distillation, by cautiously adding 60 parts of strong sulphuric acid to 5 parts of water (*not* the reverse), and pouring this on 100 parts of well-dried acetate of lime. The mixture is digested with occasional agitation in a nearly closed stoneware or glass vessel, and the clear liquid decanted and strained.

II. From the *Acetates per se:*

a. From ACETATE OF COPPER:—AROMATIC VINEGAR†; SPIRIT OF VERDIGRIS†; SPIRITUS VENERIS,† L.; ESPRIT DE VENUS, Fr.; ACIDUM ACETICUM, Ph. L. 1787. Before pyroligneous acid was known, there was only one method of obtaining strong vinegar practised by chemists, viz. by the dry distillation of verdigris. The



A, Furnace.
B B B B, Glass receivers.
C, Stoneware retort.
D, Bottle containing vinegar.
E E E E, Basins containing water.
F F F F, Supports for basins.
G, Welter safety-tube.
H, Supply-pipe of cold water.
I I I I, Cocks to supply water to the basins.
J, Water main.
L, Adapter connecting retort and globes.

process is as follows:—Crystallised verdigris (acetate of copper, $Cu(C_2H_3O_2)_2 + H_2O$), carefully dried by a gentle heat, is introduced into a large stoneware retort (see figure), the bottom of which has been previously coated with a mixture of clay and horse-dung, to render it more capable of resisting the fire. The retort is next placed in a suitable furnace, and connected by means of an adapter with three or four tubulated globes, the last of which must have a vertical tubulature, to which a double *Welter's* safety tube is attached; the other end of the safety tube dips into a vessel half filled with distilled vinegar, while the funnel portion is open to the atmosphere. The globes are kept cool in basins of water through which a stream is constantly flowing, the upper portions being further covered with wet cloths. The heat of the retort must be carefully regulated, so as to have a fairly steady distillation. When no more vapour comes over, the acid (which contains traces of copper, and therefore requires to be redistilled) is collected from the various bulbs, and rectified from a glass (not metal) retort, with a suitable condensing arrangement. The retort should not be more than half full, and its tube should be so bent over the blowpipe as to give it the form of a low arch, which prevents any spirting over. The distillation must be discontinued before all the acid has passed over, as the last portion is apt to injure the flavour and colour of the rest. The first portions being very weak, the distillate may be collected in separate fractions if wanted.

Good diacetate of copper, if properly distilled in this way at a temperature of 204°—293° C. (400°—560° F.), yields fully half its own weight of a greenish-coloured acid of about 1·061 sp. gr., and containing above 50% $C_2H_4O_2$. 20 lbs. of the acetate yield 9⅝ lbs. crude acid, and leave a residue of about 6½ lbs. of metallic copper mixed with a little charcoal; the remainder (*i. e.* nearly one fifth of the acid in the acetate) is decomposed by the heat and lost. The above 9⅝ lbs. of crude acid yield, on fractionation, ½ lb. acid of 1·023 sp. gr., 3 lbs. of 1·042, and 6 lbs. of 1·065. In the first distillation the strongest acid is found in the third receiver, and the weakest in the first. The acid obtained in this way has a pleasant aroma, whence its use as aromatic vinegar and in perfumery. It is the *radical vinegar* of the alchemists. The residue left in the retort, being in a very fine state of division, may take fire spontaneously when air is allowed to enter; caution must therefore be observed with regard to it. In this process care must be taken to avoid overfiring, as thereby the yield is lessened and the quality of the acid injured.

In all the methods (leaving the last out of account) just given for the manufacture of acetic acid, the product becomes more concentrated in proportion to the dryness of the acetate and the strength of the sulphuric or hydrochloric acid employed. By using the one dry and the other concentrated, glacial acid may always be obtained by collecting separately the last two fifths that come over, and submitting this to refrigeration.

In distilling weak solutions of acetic acid, it is found useful to add from 25% to 30% of sodium chloride, which raises the boiling temperature of the liquid, and thus enables the acid to pass over more easily (*Stein*); should any free sulphuric acid be present, sulphate of sodium must obviously be added instead of the chloride. Unless this addition be made, the whole of the acid cannot be obtained without distillation to dryness and consequent generation of empyreuma. The acetic acid of commerce is almost wholly obtained from the acetates of soda and lime. The principal supply of crude acetate of soda is from America, Norway, and Sweden, but much is also obtained from our home manufactories.

Impurities in Acetic Acid. The acid of commerce, being commonly prepared by distilling the acetates of soda or lime with sulphuric or hydrochloric acid, is liable to contain traces of these acids, and also of sulphurous acid. *Sulphuric acid* and *sulphates* are tested for by the addition of barium chloride and hydrochloric acid. *Sulphurous acid* and *sulphites* are detected by adding more than enough chloride of barium to precipitate all the sulphuric acid present, filtering, and then adding bromine water to the filtrate, when a fresh precipitate of barium sulphate is thrown down if any sulphurous acid or sulphite is present. *Hydrochloric acid* and *chlorides* are tested for by the addition of nitrate of silver and nitric acid. *Copper* and *lead* are tested for thus: A sufficient quantity of the acid is evaporated to a small bulk, diluted with water, a few drops of hydrochloric acid added, and sulphuretted hydrogen passed through the solution, when—if lead or copper is present—a brown or black colouration or precipitate is produced. Should the liquid to be tested contain much organic matter, it must first be evaporated to dryness, the residue ignited on porcelain, and the ash dissolved in a little hydrochloric acid.

"A delicate test for copper is the red-brown precipitate or colouration produced by the addition of a few drops of a solution of potassic ferrocyanide, $K_4Fe(CN)_6$, either to the original liquid, or to the same concentrated by evaporation and then diluted again with water. If iron be present in such quantity as to give a blue precipitate and thus interfere with the reaction, it must first be removed by the addition of bromine water and then excess of ammonia, and the copper sought for in the filtrate after acidifying it with hydrochloric or acetic acid" (*Allen*).

Salts of lime are tested for by partially neutralising the solution with ammonia and adding oxalate of ammonium. *Empyreumatic substances:* the acid is neutralised exactly with sodic carbonate, and the odour and taste of the warm liquid observed.

Properties. Pure acetic acid ($C_2H_4O_2$) is at low temperatures a colourless, crystalline, hygroscopic solid, and above 16·5° C. (61·7° F.) a colourless, mobile liquid of pungent sour taste and odour, which distils unchanged and blisters the skin. A small addition of water lowers the melting point considerably, *e. g.* an acid containing 13% of water melts below 0°; after the addition of water reaches a certain point, the melting temperature rises again. On mixing with water, heat is evolved, and there is a contraction in volume until 23% of water is present (corres-

ponding to the formula $C_2H_4O_2$, H_2O). This acid has a higher specific gravity than the glacial, so that either concentration or dilution decreases its density. Acids of 43% and 100% have about the same specific gravity (see table). The acid of the British Pharmacopœia contains 33% by weight, and has a density of 1·044. Dilute acetic acid (B.P.) is prepared by mixing one volume of the above with seven of water; it has a specific gravity of 1·006 and contains 4·27% acid. The glacial acetic acid of the Pharmacopœia is said to have a density of 1·065 to 1·066, and to contain at least 98·8% of acid. It should crystallise at 1·1° C. (34° F.), and remain solid till heated above 8·9° C. (48° F.). The glacial acid should contain at least 97% $C_2H_4O_2$. This can be tested by shaking up one volume of the sample with nine volumes oil of turpentine, when complete solution occurs if it contains 97% or over. Samples containing 99·5% of acid are miscible with turpentine in all proportions. Absolute acetic acid is miscible in all proportions with water, alcohol, and ether. It is a good solvent for essential oils, camphor, resins, &c., and for many metallic salts insoluble in water. The vapour given off from the boiling liquid is inflammable and burns with a blue flame. Acetic acid is exceedingly stable and difficult to oxidise, even chromic acid having no effect upon it.

Physical Effects, Uses, &c. In its concentrated form acetic acid acts like the mineral acids as a corrosive poison, dissolving and destroying the tissues; and, when used as a poison, which is a comparatively rare occurrence, or taken by accident, which is somewhat difficult on account of its strong and penetrating odour, it causes death in the same way as the mineral acids. See POISONING.

It is used externally as a rubefacient, sometimes as a vesicant and escharotic; the glacial acid is the most effective for these purposes. One of its most familiar applications is as a corn solvent, for which purpose its power of softening and dissolving the epithelial tissues renders it a suitable agent. Considerably diluted, it is often of much service in fevers, for sponging the surface of the body, producing as it does a cooling and refreshing effect upon the skin; used in this way it also serves to check excessive perspiration. In therapeutics its chief application is as a solvent. The use of acetic acid in the form of vinegar as a disinfectant is very ancient, and there still exist, in many parts of England, stones, on which money which had been dipped in vinegar was deposited during outbreaks of the plague, in payment for goods left near the same spot by those who wished to sell, but who were afraid of contact with the buyer; its value as a disinfectant when used in this way was probably *nil.*

Used as a fumigation it is of some service in disguising the unpleasant smell of a sick room or of crowded assemblies, but there are other less objectionable, and at the same time more efficient, methods of effecting the same purpose. See VENTILATION and DISINFECTANTS. Aromatic acetic acid is a favourite ingredient for smelling bottles, and in this form is of use as a local stimulant.

The use of acetic acid in the form of vinegar for pickling is well known. So-called white-wine vinegar is occasionally little else than dilute sulphuric acid; this can very easily be detected by the addition of a few drops of a solution of barium chloride, which, if sulphuric acid be present, will cause a white precipitate.

In the arts acetic acid is very largely used, by dyers and calico printers for the preparation of the acetates of iron and alumina, which are known respectively as Iron and Red liquors. It is also used in the manufacture of many dyes, especially aniline compounds. In photography its uses are very numerous; the lithographer employs it for etching his stone, and the engraver and etcher for 'biting' their copper and zinc plates. There are very few of the arts in which acetic acid in one form or another does not find some application.

Tests for Acetic Acid. These are given in full under ACETATES.

Quantitative determination of Acetic Acid in aqueous solutions of the Pure Acid, Vinegar, Beer, Wine, Pyroligneous Acid, and Metallic Acetates. (Read in connection with this, the articles 'ACIDIMETRY' and 'ALKALIMETRY.') The following books have been consulted in writing this portion of the article: *Sutton's* 'Volumetric Analysis;' *Allen's* 'Commercial Organic Analysis;' *Fresenius'* 'Quantitative Chemical Analysis;' *Thorpe's* 'Quant. Chem. Analysis.' For details the reader is referred to the first three mentioned.

1. *In mixtures of pure Acetic Acid and Water.* As will be seen by a glance at the table of specific gravities of mixtures of acetic acid and water, the strength of any given sample cannot be determined with the same confidence as in the case, say, of sulphuric or hydrochloric acid, by means of the hydrometer. The sp. gr. method is only applicable when dealing with mixtures of pure acetic acid and water. Further, these should not contain more than 50% of acid; when they do, they should be diluted with a known volume of water. The percentage of acid present is best ascertained by titration with standard alkali, *e.g.* N-caustic soda solution. In this case, if the liquid is not too dark coloured, phenol-phthaleïn is the best indicator to use, sodic acetate being absolutely neutral to it, although slightly alkaline to litmus. Failing phenol-phthaleïn, litmus should be employed, and—if the solution be dark—litmus paper.

2. *In Vinegar, Beer, and Pyroligneous Acid.*

a. In cases of necessity, a measured portion of the vinegar may be distilled until all its acid has come over, the distillate made up to a given volume and its specific gravity taken. This method, however, is only moderately accurate, and titration with alkali is much to be preferred.

b. By direct titration as above. When the vinegar is not too highly coloured, phenol-phthaleïn may be employed as indicator (cf. the determination of mineral acids in vinegar, when such are present.

c. Mohr's process (applicable to vinegar, beer, and to pyroligneous acid). A weighed quantity of finely powdered marble, more than sufficient to neutralise all the free acid present, is added to a measured quantity of the sample under examin-

ation in a small flask, the reaction allowed to complete itself as far as possible in the cold, and ultimately finished by careful warming. The residual carbonate is then filtered, washed with boiling water, dissolved in a measured excess of N-HCl, and the solution then titrated back again with N-alkali. The acetic acid present in the original sample is of course equivalent to the amount of carbonate of lime dissolved by it, 120 parts by weight of the former being equivalent to 100 of the latter, thus:

$$\underset{\text{Calc. carbonate.}}{CaCO_3} + \underset{\text{Acetic acid.}}{2H(C_2H_3O_2)} = \underset{\text{Calc. acetate.}}{Ca(C_2H_3O_2)_2} + H_2O + CO_2$$

This is a good practical method for all acetic acids, however dark coloured they may be; indeed it is specially applicable for samples of dark pyroligneous acid.

3. *In Commercial Acetates.*

a. In Acetate of Lime, $Ca(C_2H_3O_2)_2$ [the crystallised salt has the composition $Ca(C_2H_3O_2)_2 + H_2O$], &c. The commercial product frequently contains much tarry matter, besides hydrate, carbonate, and sulphate of calcium, &c. It follows, therefore, that an attempt to determine the amount of pure acetate present by igniting a weighed quantity and weighing the residual carbonate (according to the equation:

$$Ca(C_2H_3O_2)_2 = \underset{\text{Calc. carbonate.}}{CaCO_3} + \underset{\text{Acetone)}}{(CH_3)_2CO}$$

yields results which are quite misleading. This method could only be adopted in the case of pure acetates. A method much followed (and one applicable to all acetates whose bases are completely precipitated by carbonate of soda, *e.g.* acetates of calcium, iron, and lead) is to boil a solution of the sample of known strength with a measured excess of $N-Na_2CO_3$ solution, filter, wash thoroughly, and titrate the excess of alkaline carbonate in the filtrate with N-acid. The loss of alkalinity which the sodic carbonate has undergone represents, of course, the amount of acetic acid present, thus:

$$Ca(C_2H_3O_2)_2 + Na_2CO_3 = 2NaC_2H_3O_2 + CaCO_3.$$

This method avoids the error caused by the presence of hydrate or carbonate of lime in the sample, but is apt to yield too high results, from the acid nature of many of the tarry products present. It gives, of course, the total acid present in any acetate, both combined and free (free acid may be present, *e.g.* in solutions of iron acetates). If salts of inorganic acids are present, *e.g.* sulphates or chlorides, this process cannot be used unless modified as follows:—The excess of sodic carbonate (after filtering from the carbonate of lime, as above) is neutralised *exactly* by hydrochloric acid, the solution evaporated to dryness, and the residue ignited; the carbonate of soda then resulting from the ignition of the acetate is now titrated by N-acid, the amount of the latter used being equivalent to that of the acetic acid originally present in the acetate.

But the best method for the estimation of acetic acid in acetates is that of Stillwell and Gladding, and of Harcourt Phillips. Here a given amount of the acetate is distilled with excess of either sulphuric acid, acid sodium sulphate, or—best of all—phosphoric acid, and the acetic acid which collects in the receiver is titrated with standard alkali. It is necessary to use phosphoric acid if the acetate contains any organic matter, as this would reduce part of the sulphuric acid or acid sulphate employed, to sulphurous acid, and thus the amount of acetic acid (apparently) found would be higher than the truth. The phosphoric acid must be free from nitric and other volatile acids; should it contain these, they must be removed by adding to it a little carbonate of ammonia, and heating the mixture to fusion in a platinum crucible or basin. The method is described in *Sutton*, p. 73, almost exactly as follows:

"A 100 to 120 c.c. retort, the tubulure of which carries a small funnel fitted with a caoutchouc stopper, the neck of the funnel being tightly stopped with a glass rod shod with elastic tube, is supported upon a stand in such a way that its neck inclines upwards at an angle of about forty-five degrees; the end of the retort tube is drawn out and bent, so as to fit into the condenser by help of an elastic tube. The greater part of the retort neck is coated with flannel, so as to prevent too much condensation.

"One gramme of the sample being placed in the retort, 10 c.c. of a 40% solution of P_2O_5" (*i. e.* a solution of phosphoric acid, H_3PO_4, of 1·2 sp. gr.) "is added, together with as much water as will make about 50 c.c. A small naked flame is used" (or a sand-bath), "and, if carefully manipulated, the distillation may be carried on to near dryness without endangering the retort. After the first operation the retort is allowed to cool somewhat, then 50 c.c. of hot water are added through the funnel, another distillation made as before, and the same repeated a third time, which will suffice to carry over all the acetic acid. The distillate is then titrated with alkali and phenol-phthaleïn.

"By this arrangement the frothing and spirting are of no consequence, and the whole process can be completed in less than an hour. The results are excellent for technical purposes." (*Sutton.*)

Should the sample of acetate contain any chloride, a little sulphate of silver must be added to the contents of the retort before distilling. If sulphate of silver is not available, a portion of the distillate must be tested for hydrochloric acid with nitrate of silver. Should only a faint opalescence be produced, as is generally the case, the titration of the remainder (measured) may be proceeded with. Should, however, a precipitate of silver chloride be obtained, the hydrochloric acid must be determined in this way, if necessary in a fresh distillate (see Hydrochloric Acid, Estimation of), and deducted from the total acid found. (*Fresenius.*)

This method may also be used for determining the amount of acetic acid in *wine*. The acid present in the wine is neutralised with hydrate of baryta, $Ba(OH)_2$, the alcohol distilled off, phosphoric acid added to the residual barium acetate, and the distillation proceeded with as above.

The results of the 'assay' of commercial acetates vary somewhat according to the method followed. Wherever possible, the process of distillation with phosphoric acid should be adopted. Of course, to carry it out successfully, a certain degree of manipulative dexterity on the part of the analyst is required.

Table showing the Specific Gravities of Mixtures of Acetic Acid and Water at 15° C. (59° F.). (OUDEMANNS.)

Acetic Acid ($C_2H_4O_2$) per cent.	Density.	Acetic Acid ($C_2H_4O_2$) per cent.	Density.
0	0·9992	51	1·0623
1	1·0007	52	1·0631
2	1·0022	53	1·0638
3	1·0037	54	1·0646
4	1·0052	55	1·0653
5	1·0067	56	1·0660
6	1·0083	57	1·0666
7	1·0098	58	1·0673
8	1·0113	59	1·0679
9	1·0127	60	1·0685
10	1·0142	61	1·0691
11	1·0157	62	1·0697
12	1·0171	63	1·0702
13	1·0185	64	1·0707
14	1·0200	65	1·0712
15	1·0214	66	1·0717
16	1·0228	67	1·0721
17	1·0242	68	1·0725
18	1·0256	69	1·0729
19	1·0270	70	1·0733
20	1·0284	71	1·0737
21	1·0298	72	1·0740
22	1·0311	73	1·0742
23	1·0324	74	1·0744
24	1·0337	75	1·0746
25	1·0350	76	1·0747
26	1·0363	77	1·0748
27	1·0375	78	1·0748
28	1·0388	79	1·0748
29	1·0400	80	1·0748
30	1·0412	81	1·0747
31	1·0424	82	1·0746
32	1·0436	83	1·0744
33	1·0447	84	1·0742
34	1·0459	85	1·0739
35	1·0470	86	1·0736
36	1·0481	87	1·0731
37	1·0492	88	1·0726
38	1·0502	89	1·0720
39	1·0513	90	1·0713
40	1·0523	91	1·0705
41	1·0533	92	1·0696
42	1·0543	93	1·0686
43	1·0552	94	1·0674
44	1·0562	95	1·0660
45	1·0571	96	1·0644
46	1·0580	97	1·0625
47	1·0589	98	1·0604
48	1·0598	99	1·0580
49	1·0607	100	1·0553
50	1·0615		

Acetic Acid, Aromat'ic. *Syn.* AROMATIC VINEGAR; A. SPIRIT OF V.; ACIDUM ACE'TICUM AROMAT'ICUM, L.—*Prep.* 1. (Ph. E. 1839.) Dried rosemary and origanum, of each 1 oz.; lavender flowers, ½ oz.; bruised cloves, ½ dr.; acetic acid (sp. gr. 1·068), 1½ pint; macerate for 7 days, express, and filter. A fragrant and refreshing perfume. Omitted in Ph. E. 1841 and P. B. 1867.

2. (Ph. E. 1817.) As the last, but using distilled vinegar instead of the strong acid of the Pharmacopœia. Inferior.

3. (P. Cod. 1839.) Camphor, 2 oz.; oil of lavender, 10 gr.; oil of cinnamon, 20 gr.; oil of cloves, 30 gr.; concentrated acetic acid, 1 pint. Very fragrant and refreshing.

4. (Ph. Bor. 1847; Cod. Med. Hamb. 1845.) Oil of cloves, 1 dr.; oils of lavender and citron, of each 2 scrup.; oils of bergamot and thyme, of each 1 scrup.; oil of cinnamon, 10 drops; strongest acetic acid, 1 oz.; mix. Limpid; yellow-brown; highly fragrant and refreshing. See ACETIC ACID (Camphorated), and VINEGAR (Aromatic).

5. Glacial acetic acid, oil of cloves, camphor, of each 1 oz.; mix and dissolve.

Acetic Acid, Cam'phorated. *Syn.* CAMPHORATED VINEGAR; ACIDUM ACE'TICUM CAMPHORA'TUM, L.—*Prep.* 1. (Ph. E. 1841.) Camphor, ½ oz.; pulverise it by means of a few drops of spirit of wine, and then dissolve it in acetic acid (Ph. E.), 6½ fl. oz.

2. (Ph. D. 1850.) Camphor, 1 oz.; rectified spirit, 1 fl. dr.; pulverise, and dissolve in strong Acetic Acid (Acid. Acet. fort. Ph. D.), 10 fl. oz.

Obs. This preparation is intended as a substitute for the aromatic acetic acid of the shops and previous pharmacopœias. It is also useful as an embrocation in rheumatism and neuralgia; as an extemporaneous vesicant and counter-irritant; and as a fumigation in fevers, &c.

Acetic Acid, Dilute'. *Syn.* ACIDUM ACETICUM DILU'TUM, L. Acetic acid, 1 pint; distilled water, 7 pints; mix. Sp. gr. 1·006. One fluid ounce corresponds to 16 gr. of anhydrous acid (3·63%).

ACETIC ACID, GLACIAL. *Syn.* ACIDUM ACETICUM GLACIALE. Made by heating carefully 54 parts crystallised sodium acetate until the water of crystallisation is driven off; the fused residue is coarsely powdered, placed in a retort with 40 parts pure concentrated sulphuric acid, and distilled; the distillate is glacial acetic acid.

Characters. It crystallises when cooled, and remains so until the temperature rises to 15·5° C. It contains nearly 99% real acetic acid, $HC_2H_3O_2$. Sp. gr. 1·058; this is increased by adding 10% of water. Impurities are often present, in the form of sulphuric, sulphurous, and butyric acids.

Uses. In *surgery*, as an application for removal of corns and warts. In *pharmacy*, as a solvent of creosote and volatile oils, likewise to remove active principles from drugs, as cantharidine from Spanish fly, and emetine from ipecacuanha.

ACETIC ANHYDRIDE. See ANHYDROUS ACETIC ACID.

ACETICA. [L.] Medicated vinegars.

ACETIDUX, Dr DELFER'S. Made by Döllinger, of Berlin. For the radical and painless removal of warts, corns, hard skin, &c. A solution of 5 grms. of chromic acid in 15 grms. of water. (*Schadler.*)

ACETIFICATION. See VINEGAR.

ACETIMETRY. *Syn.* ACETOMETRY; ACETOMETRIE, Fr. The determination of the quantity of absolute acetic acid, $C_2H_4O_2$, in vinegar or any other liquid. See ACETIC ACID, ALKALIMETRY, and ACIDIMETRY.

ACETINE, HOCHSTETTER'S. Prepared by J. C. F. Witte, Berlin. A remedy for corns, warts, and hard skin. Diluted vinegar, coloured with blue carmine, 16 grms. (*Schadler.*)

ACETOLATS. [Fr.] *Syn.* ESPRITS ACETIQUES. In *French pharmacy,* medicated vinegars obtained by distillation.

ACETOLES. [Fr.] In *French pharmacy,* medicated vinegars obtained by maceration.

ACETO-PHENONE. See HYPNONE.

ACETOUS FERMENTATION. See ACETIFICATION and VINEGAR.

ACETUM. [L.] Vinegar.

ACETYL. CH_3-CO-, frequently contracted to 'Ac.' The radicle of acetic acid. It does not exist in the free state, but only in combination, thus: Acetyl chloride, CH_3-CO-Cl; acetic acid, CH_3-CO-OH or Ac-OH.

ACETYLENE. *Syn.* ETHINE, C_2H_2, or $CH \equiv CH$. This unsaturated hydrocarbon, the simplest member of an important series, can be obtained by the direct combination of carbon and hydrogen, and is produced in considerable quantity by the incomplete combustion of many organic compounds, *e. g.* when the gas in a *Bunsen* burner burns 'below,' *i. e.* within the chimney. It is present in very small quantity in coal gas itself. The most convenient method of preparing it is to act upon ethylene bromide with an alcoholic solution of caustic potash. Acetylene has a peculiar odour, burns with a sooty flame, and is soluble in its own volume of water and in $\frac{1}{6}$th of its volume of alcohol. It is absorbed by an ammoniacal solution of cuprous chloride, Cu_2Cl_2, with formation of the peculiar red precipitate, copper-acetylene $CuCu_2$, H_2O, which—when dry—explodes upon being struck; similar compounds are obtained with silver and other metals. The formation of such explosive compounds is characteristic of all the true acetylenes (*i. e.* true homologues of acetylene). They yield acetylene gas when acted upon by aqueous hydrochloric acid, this being in fact the best way of preparing acetylene pure, thus:

$$C_2Cu_2, H_2O + 2HCl = C_2H_2 + Cu_2Cl_2 + H_2O.$$

ACHAR. See PICKLES.

ACHILLE'INE (-kĭl-). A peculiar bitter principle obtained from *Achille'a millefolium* (Linn.), or yarrow.

A'CHOR (-kŏr). [Gr.] See SCALD-HEAD.

ACHROMAT'IC (ăk-ro-). *Syn.* ACHROMATIQUE, Fr. In *optics,* devoid of colour; bodies that transmit light without decomposition, and consequently, without the formation of coloured rings or fringes; applied to compound lenses, prisms, &c., and to instruments fitted with them.

ACHRO'MATISM. *Syn.* ACHROMATISME, Fr. In *optics,* the state of being achromatic; the absence of coloured fringes in the images of objects seen through a lens or prism.

Light is not homogeneous, but decomposable by refraction, absorption, or reflection, into coloured rays of unequal refrangibility. A ray of white light, in passing through a glass prism, is entirely separated into the coloured rays forming the 'prismatic spectrum;' and when it passes through a lens, an analogous resolution into coloured rays still occurs, though not so readily observed, and that to an extent often incompatible with distinct vision. Now, if a convex lens be regarded as a number of prisms united by their bases round a common centre, and a concave lens, as a similar number of prisms with their apices in contact, the action of lenticular and prismatic glasses on light will be reduced to a common principle. A beam of light thrown on a simple converging lens not only suffers refraction at the spherical surface (SPHERICAL ABERRATION), but the different coloured rays of which it is composed, from the causes mentioned, being unequally bent or refracted, diverge from their original course (CHROMATIC ABERRATION), forming as many foci on the axis of the lens as there are colours, and fall separately, instead of together, on the eye or object which receives them. Hence arise the coloured fringes or halos that surround objects viewed through ordinary glasses, and which form the great impediments to the construction of perfect lenses. This effect, like the refractive power and focal distance, varies in degree in different diaphanous substances.

The correction of the chromatic aberration of lenses is commonly effected by combining two, or more, made of materials possessing different 'dispersive' powers. Thus, the spectrum formed by flint glass is longer than that formed by crown glass, for the same deviation. When the two are combined, so as to form a compound lens, the one tends to correct the 'dispersion' of the other. On this principle ACHROMATIC GLASSES are generally formed in this country. A convex lens of crown glass is combined with a weaker concave lens of flint glass, the latter counteracting the dispersion of the former, without materially interfering with its refractive power. The resulting combination is not absolutely achromatic, but is sufficiently so for all ordinary purposes. According to Dr Blair, a compound lens perfectly achromatic for the intermediate, as well as for the extreme rays, may be made by confining certain fluids, as hydrochloric acid, between two lenses of crown glass. In order to produce nearly perfect achromatism in the object-glasses of telescopes, microscopes, cameras, &c., a concave lens of flint glass is commonly placed between two convex lenses of crown or plate glass, the adjacent surfaces being cemented with the purest Canada balsam, to prevent the loss of light by reflection from so many surfaces.

Dollond, of London, about the year 1757, discovered the achromatic properties of a compound lens made by combining crown and flint glass.

ACIC'ULAR. Needle-shaped; slender or sharp pointed; spicular; in *botany,* applied to leaves, and in *chemistry,* to crystals. The last are also sometimes termed ACIC'ULÆ.

ACID. *Syn.* ĂCIDUM, L.; ACIDE, Fr.; ACIDO, Ital.; SÄURE, Germ. An acid is a compound containing hydrogen, the latter being capable of replacement wholly or partially by metals (or by groups of elements which play the part of metals, *e.g.* the group NH_4), with the formation of salts. An acid may also be defined as a salt of hydrogen.

Basicity of Acids. When an acid reacts with the oxide or hydroxide of potassium or sodium, it may form one, two, or more salts. Should it be found to be capable of forming only one, it is termed monobasic, *i. e.* it contains in its molecule only one atom of replaceable hydrogen, *e. g.* hydrochloric acid, HCl; salt: potassium chloride, KCl. Should it give rise to two salts, then it is dibasic, *e. g.* sulphuric acid, H_2SO_4; salts: potassium hydrogen sulphate, $KHSO_4$; normal potas-

sium sulphate, K_2SO_4. If three salts, then it is tribasic, *e.g.* phosphoric acid, H_3PO_4; salts: sodium dihydrogen phosphate, NaH_2PO_4; disodium hydrogen phosphate, Na_2HPO_4; normal sodium phosphate, Na_3PO_4. (*Note.* The 'normal,' or 'neutral' salts as they are also sometimes termed, are those in which all the replaceable hydrogen of the acid has been substituted, while the 'acid' or 'hydrogen' salts still contain replaceable hydrogen.) In like manner acetic acid, $H(C_2H_3O_2)$, is found to be monobasic, oxalic acid, $H_2(C_2O_4)$, dibasic, citric acid, $H_3(C_6H_5O_7)$, tribasic, and so on. Acids of greater basicity than the monobasic are also frequently termed polybasic. Acids likewise form salts with ammonia, and with the more complicated nitrogen bases, as examples of which may be mentioned ammonium chloride, NH_4Cl or NH_3, HCl; aniline hydrochloride, $C_6H_5NH_2$, HCl; morphine acetate, $C_{17}H_{19}NO_3$, $HC_2H_3O_2$, &c.

General Properties. Most of the common acids are soluble in water, possess a sour taste, decompose carbonates with effervescence, and turn a solution of blue litmus red. The name 'mineral' acids is still applied to those prepared from mineral substances, *e.g.* hydrochloric, nitric, and sulphuric acids, in contradistinction to the term 'organic' acids, which refers to those obtained from organic substances, *e.g.* acetic and tartaric acids. The acids which are of greatest importance technically will be referred to in detail.

ACIDIMETER. *Syn.* ACIDOMETER; ACIDIMETRUM, L.; ACIDIMÈTRE, Fr. See BURETTE.

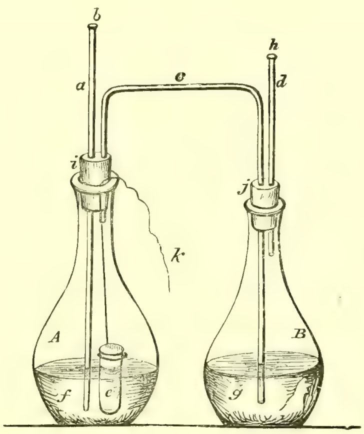
ACIDIMETRY. *Syn.* ACIDIMÉTRIE, Fr. The estimation of the quantity of free acid in any liquid. This article must be read in conjunction with the one on *Alkalimetry*, the two being complementary; in fact, but little remains to be added here to what is said under the latter head.

1. In the case of acids free from any appreciable impurity, the strength can usually be determined with sufficient exactitude by merely taking the specific gravity (see SPECIFIC GRAVITY), and then referring to a good table of specific gravities of the acid in question.

2. Should it be wished to titrate the acid with standard alkali or alkaline carbonate solution, it is best to weigh out a small portion accurately in a tightly stoppered bottle, and then dilute to a convenient strength, say, to about the strength of 'normal' acid.

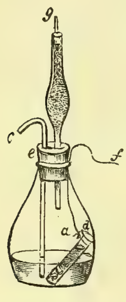
3. *Kiefer's* method. Here an ammoniacal solution of oxide of copper is employed as the standard solution, and the 'point of neutralisation' is seen by the turbidity which is observed as soon as the free acid present is saturated, the precipitate then forming remaining insoluble in the previously clear liquid. The standard solution is prepared by adding liquid ammonia to an aqueous solution of sulphate of copper ($CuSO_4 + 5H_2O$) until the precipitate which at first forms is nearly, but *not quite*, redissolved, and filtering. The filtrate is then made up to a litre, and titrated by allowing a portion to fall from a burette into 10 to 15 c.c. of normal sulphuric or nitric acid, so as to get its exact strength, which must be redetermined from time to time. This method answers well for all the stronger acids, excepting oxalic, even when dilute, and it has the great advantage that the solution is not affected by the presence of a neutral (*i. e.* normal) metallic salt with an acid reaction, such as sulphate of copper or sulphate of zinc. It is therefore of value in estimating the amount of free acid in metallic mother liquors, &c.; the process is also especially applicable to the titration of the acid in vinegars (*Sutton*). If cupric nitrate instead of sulphate be used for preparing the standard solution, the presence of barium, strontium, and other metals precipitable by sulphuric acid is of no consequence.

4. *Fresenius'* and *Will's* gravimetric method may likewise be followed in the estimation of acids. This depends on the weight of carbon dioxide (CO_2) which a given weight of the acid under examination is capable of expelling from an excess of pure bicarbonate of potash or soda, and the apparatus used is the same as that described under the article ALKALIMETRY, with slight modifications (see figure, *below*). The operation is conducted as follows:—A convenient amount of the acid in question is accurately weighed into flask *A*, and, should it be a concentrated liquid or a solid, it is mixed with or dissolved in six to eight times its volume of water. The little glass tube (*e*) is then nearly filled with pure bicarbonate of soda ($NaHCO_3$) in powder,



and a fine silken thread is tied round its neck, by means of which it can be lowered into the flask (*A*), so as to remain perpendicularly suspended when the cork is placed in the latter, the thread being held fast between the cork and mouth of the flask. Flask *B* is filled about half full with concentrated sulphuric acid, and the whole apparatus tested for tightness (as in ALKALIMETRY); when quite cold it is weighed. The stopper from tube *d* being taken off, the cork in *A* is then slightly loosened, so as to allow tube *e* to fall into the acid, and again instantly fixed air-tight. The evolution of carbonic acid now commences, and continues until the acid in *A* is neutralised. When this takes place, which is easily seen by no bubbles being emitted on shaking the apparatus, *A* is put into warm water of 40°—45° C. (120°—130° F.), and kept there, with occasional agitation, until the renewed evolution of the gas has completely ceased. The

stopper from *a* is then removed, the apparatus taken out of the hot water and wiped dry, and suction applied (see ALKALIMETRY) till the carbonic acid in the flasks is completely displaced by air; it is then stoppered up, allowed to cool, and weighed again, using the same precautions as before. The loss in weight represents the amount of carbon dioxide expelled from the bicarbonate by the acid in question, from which the amount of acid itself can readily be calculated, thus:—one *equivalent* of acid expels one *equivalent* of carbon dioxide $\frac{CO_2}{2}$. *Examples:*—36·5 parts by weight of hydrochloric acid, HCl, or 49, *i. e.* $\frac{98}{2}$ parts by weight of sulphuric acid, H_2SO_4, or 60 parts by weight of acetic acid, $HC_2H_3O_2$, are equivalent to 22 *i. e.* $\frac{44}{2}$ parts by weight of carbon dioxide, CO_2. (See table of Acidimetrical and Alkalimetrical equivalents.)



Instead of using two small flasks here, as above described, the one containing the sulphuric acid may be replaced by a tube *g* filled with small pieces of chloride of calcium, as shown in figure. Tube *g* should be loosely plugged with cotton wadding at both ends, to prevent any of the chloride falling out.

ACID′ITY. *Syn.* ACID′ITAS, L.; ACIDITÉ, Fr.; SÄURE, Ger. In *chemistry*, the state of being acid. In *physiology*, &c., the impression given to the organs of taste by tart or acid substances. Sourness. See FERMENTATION, MALT-LIQUORS, WINES, &c.

Acidity, Gas′tric. Acidity of the stomach; a common and well-known symptom of weak or disordered digestion.

Treat., &c. Active exercise and regular habits, combined with attention to diet, will effect a cure in most cases. The food should chiefly consist of fish, fowl, and eggs; sweet dishes should be avoided, as also excess of farinaceous food and fruit; beer and sweet wines are also very apt to provoke acidity. If alcohol be required, a little good whisky is the best to take. The occasional use of mild saline aperients has a good effect in checking irregularities of the bowels. Mercurials should be rigorously avoided, as also the continual use of carbonate of soda and bicarbonate of potash.

Small doses of dilute nitro-hydrochloric acid, taken about half an hour before meals, will often diminish acidity or cause it to disappear. In those cases in which the gastric acidity is dependent upon feeble health, and is a symptom rather than a disease, special treatment will be required.

Acidity in Infancy. Is a very common result of excessive and improper feeding. Sour eructations, flatulence with vomiting and diarrhœa, in bad cases, are the common signs, with restlessness and constant crying. In most cases the remedy is simple; extreme regularity in quantity of food and times of feeding, milk with lime water, or milk mixed with the same quantity of barley water, is the best diet; the addition of a little dill water to the food will often correct flatulency. The greatest care should be exercised not to overload the stomach, very small doses of rhubarb and carbonate of soda may be given if there be bowel trouble present. Sugar in the food should be avoided. The child's milk may often be boiled and skimmed with advantage; but if after careful trial the use of milk or milk and water still causes acidity, it may be necessary to change the diet and use Mellin's or some other good infant food with discretion. Great care should be taken to prevent the continuance of the symptoms, as acute diarrhœa may be set up, with risk to the child's life; and unless the simple means above suggested succeed, it will be well to seek skilled advice. See under DIET, ANTACIDS, DYSPEPSIA, &c.

ACIDS, BURNS BY. See BURNS.

Acids, Effects of, on Vegetation. This subject has been ably investigated of recent years by Dr Angus Smith and Mr Rothwell, and the practical importance of their labours is shown by the circumstance that an Act of Parliament passed in 1875 renders it penal for the proprietors of alkali works to condense not less than 95 per cent. of the hydrochloric acid evolved in the process of manufacturing 'soda;' also to allow air, smoke, or chimney gases to escape into the atmosphere containing more than one fifth of a grain of hydrochloric acid per cubic foot. Every owner of an alkali work is likewise required to "use the best practical means of preventing the discharge into the atmosphere of all other noxious gases arising from such work, or of rendering such gases harmless when discharged."

The injurious effects of acids on vegetation are indicated chiefly by the shrivelled-up appearance which the leaves of herbage, trees, &c., exhibit in the vicinity of chemical works in which the condensation of noxious gases (hydrochloric acid, sulphurous acid, sulphuric acid, sulphuretted hydrogen, nitric acid, and oxides of nitrogen and chlorine) is not effectually carried out. According to Mr Rothwell, "in fields exposed to acid vapours handfuls of dead grass may be pulled up in the spring, smelling strongly of the vapour, and that trees, under similar influences become bark-bound."

The following is a list of trees arranged in the order of their susceptibility. (*Rothwell.*)

Forest Trees. Larch, spruce fir, Scotch fir, black Italian poplar, Lombardy poplar, ash, oak, elm, birch, alder, sycamore.

Fruit Trees. Damson, greengage, Halewood plum, Jacob plum, pears, apples, cherries.

Shrubs, Evergreens, and Wild Plants. British laurels, Portugal laurels, *Aucuba japonica*, Barberry evergreen, hazel, guelder rose, sloe thorn, hawthorn, raspberries, gooseberries, blackberries, gorse, hollies.

Farm Crops. Potatoes, mangel, white clover and rhubarb, red clover, trefoil, rye-grass, wheat, oats, barley, common turnips, swedes.

Second list of Plants affected by Noxious Vapours, mixing the classes according to the effects produced on each.

I. Fern—only in the summer.

Scotch firs, spruce, and larches—a little in winter.

Clover (white and red), trefoil, rye-grass, poplars, hawthorn, potatoes—receive damage in winter to roots.

II. Wheat receives some damage in winter.

Oats in May, when in the grass state, soon receive damage.

Barley, mangel, common turnips, rhubarb.

III. Laurels (British and Portugal), aucubas, yews, holly, gorse—receive damage in winter, but more in summer.

Old grass meadows and pastures receive much damage in winter.

IV. Ashes, oaks, hazels, horse-chestnuts, walnuts, Spanish chestnuts, sloe thorn.

V. Swedish turnip and cabbages, damson, other fruit trees, beech, elm, birch, alder, sycamores.

ACIDS, POISONING BY. See POISONING.

ACID STUMPS. Small pointed pieces of box or other hard wood, used in lithography, with gum and acid, for removing specks of dirt from the stone.

ACIDULÆ. [L. pl.] In *medecine,* mineral waters rich in carbonic acid.

ACIDULATED. *Syn.* ACIDULATUS, L.; ACIDULE Fr. Blended or flavoured with an acid; made slightly sour. See KALI (Acidulated), DROPS, LOZENGES, &c. In *chemistry,* the addition of an acid to a neutral or alkaline liquid until it reddens blue litmus paper.

ACIDUM. [L.] An acid.

ACNE. An inflammation of the hair follicles, generally confined to the face, neck, upper part of the chest, back, and shoulders, and occurring at, or soon after, puberty. The disease manifests itself in the form of an eruption of pimples with a black spot in the centre, which may, or may not, enlarge and suppurate.

Treatment. General. Whatever will give tone and vigour to the system, regular habits, plain food, fresh air and exercise, with tonic medicines if necessary.

Local. The best local application is ointment of hypochloride of sulphur. Hypochloride of sulphur, 1 dr.; Potass. Carb., 10 gr.; benzoated lard, 1 oz. Liquor Arsenicalis (*Fowler*) in doses of 2 to 3 drops three times daily with a little Vin. Ferri *after* meals is often very useful.

Acne arising from the abuse of alcohol requires as a first step to its cure, total abstinence, and treatment of the patient for the general effects of alcohol. This accomplished the acne will probably disappear without special treatment.

ACOLOGY. *Syn.* In *medicine,* the doctrine of, or a discourse on, remedies or the materia medica.

AC'ONITE (-nite). *Syn.* ACONITUM, L.; ACONIT, Fr.; AKONITUM, EISENHUT, STURMHUT, Ger. Monkshood; wolfsbane. In *botany,* a genus of exogenous plants. *Nat. ord.,* Ranunculaceæ; *Sex. syst.,* Polyandria trigynia. They are characterised by showy purple or yellow helmet-shaped flowers growing in panicles, deeply-cut leaves, and perennial (usually) tap-shaped or tapering roots. The whole plant is highly poisonous, the roots being more poisonous than the leaves. In *medicine* and *materia medica,* the plant *Aconitum napellus* (which *see*).

Symptoms. Numbness and tingling in the mouth and throat, which are parched; followed by giddiness, dimness of sight, and (sometimes) delirium, but seldom complete coma; there is numbness and tingling of the limbs, a loss of power in the legs (in some cases), frothing at the mouth, severe abdominal pains, nausea, vomiting, and diarrhœa; tremors or twitchings of the voluntary muscles (sometimes), convulsions (in animals, but not in man); sharp cries; pupil (generally) dilated, very rarely contracted; pulse fitful and sinking; skin cold and livid; difficulty of breathing; general prostration; loss of sensation or feeling, insensibility, general trembling, fainting, and sudden death. The eyes are often glaring; and, in some cases, the patient is completely paralysed, yet retains consciousness to the last. The case generally proves fatal in from 1 to 8 hours. If it last beyond this period there is hope of recovery. (*Fleming.*)

Antidotes. Ammonia, or brandy, with artificial respiration if necessary: cold affusion and friction, with warm towels to the back and limbs. See ALKALOIDS.

ACONITE LEAVES (B. Ph.). *Syn.* ACONITI FOLIA, L. The fresh leaves and flowering tops of *Aconitum napellus,* Linn., gathered when about one third of the flowers are expanded, from plants cultivated in Britain.

Char. Leaves smooth, palmate, divided into five deeply-cut wedge-shaped segments; exciting slowly, when chewed, a sensation of tingling. Flowers numerous, irregular, deep blue, in dense racemes.

Prep. Extractum aconiti.

ACONITE ROOT (B. Ph.). *Syn.* ACONITI RADIX, L. The dried root of *Aconitum napellus.* Imported from Germany, or cultivated in Britain, and collected in the winter or early spring before the leaves have appeared. P. W. Squire states that the roots should be collected in the autumn when the new root is in perfection, and when there would be no difficulty in separating the old decayed roots.

Char. Usually from one to three inches long, not thicker than the finger at the crown, tapering, blackish-brown, internally whitish. A *minute* portion, cautiously chewed, causes prolonged tingling and numbness.

Prep. Aconitia, the active principle; Linimentum Aconiti, 1 oz. to 1 fl. oz.; Tinctura Aconiti, 54½ gr. to 1 fl. oz.

ACONITI FOLIA. See ACONITE LEAVES.

ACONITI RADIX. See ACONITE ROOT.

ACONITIA. $C_{30}H_{47}O_7N$. (B. P.) *Syn.* ACONITIA, L. An alkaloid obtained from aconite.

Take of

Aconite root, in coarse powder, 14 pounds.
Rectified spirit
Distilled water
Solution of ammonia
Pure ether
Diluted sulphuric acid
} of each a sufficiency.

Pour upon the aconite root 3 gallons of the spirit, mix them well, and heat until ebullition commences; then cool and macerate for four days. Transfer the whole to a displacement apparatus, and percolate, adding more spirit, when requisite, until the root is exhausted. Distil off the greater

part of the spirit from the tincture, and evaporate the remainder over a water-bath until the whole of the alcohol has been dissipated. Mix the residual extract thoroughly with twice its weight of boiling distilled water, and when it has cooled to the temperature of the atmosphere, filter through paper. To the filtered liquid add solution of ammonia in slight excess, and heat them gently over a water-bath. Separate the precipitate on a filter, and dry it. Reduce this to coarse powder, and macerate it in successive portions of the pure ether with frequent agitation. Decant the several products, mix and distil off the ether until the extract is dry. Dissolve the dry extract in warm distilled water acidulated with the sulphuric acid; and, when the solution is cold, precipitate it by the cautious addition of solution of ammonia diluted with four times its bulk of distilled water. Wash the precipitate on a filter with a small quantity of cold distilled water, and dry it by slight pressure between folds of filtering paper.

Characters and Tests. A white, usually amorphous, solid, soluble in 150 parts of cold, and 50 of hot water, and much more soluble in alcohol and in ether; strongly alkaline to reddened litmus, neutralising acids, and precipitated from them by the caustic alkalies, but not by the bicarbonates of sodium or potassium. It melts with heat, and burns with a smoky flame, leaving no residue when burned with free access of air. When rubbed on the skin it causes a tingling sensation, followed by prolonged numbness. It is a very active poison.

Aconitia, Crystallised. $C_{33}H_{43}NO_{12}$ (*Wright*), $C_{29}H_{43}NO_9$ (*Paul* and *Kingzett*). The first of these aconitines was made from *Aconitum napellus*, the second from *A. Fischeri.* Exhaust the root of wild aconite, carefully picked and powdered, with very strong alcohol, to which 1% of tartaric acid has been added. Distil at a gentle heat, and sheltered from the air, to recover the alcohol. Treat the extract with water to separate all the fatty and resinous matters. The solution which contains the aconite in the state of acid tartrate is first shaken with ether to remove colouring matters, and then the alkaloid is set free by the addition of alkaline bicarbonate, until the cessation of effervescence. A fresh treatment with ether of this alkaline solution removes the alkaloid, which crystallises upon the concentration of the ethereal liquid, with an addition of petroleum spirit. The crystals are colourless tables, rhombic or hexagonal, according to the modifications produced principally in the acute angles. Crystallised aconitia is soluble in alcohol, ether, benzine, and chloroform; insoluble in petroleum oils and glycerine.

Following are the conclusions of a thorough investigation of the subject of aconitine, given by F. Mandelin:

1. Japaconitine is identical with aconitine, and both are identical with a crystalline substance, benzoylaconine.

2. Benzoylaconine is the only active principle of *A. napellus*, the other alkaloids contained in the plant being amorphous and pharmacologically unimportant.

3. The active principle of the roots of *A. ferox* is, however, pseudoaconitine or veratroylaconine.

4. Aconitine and pseudoaconitine are pharmacologically identical, but in consequence of its molecule being larger, more veratroylaconine is required to produce the same effects as aconitine or pseudoaconitine.

5. The difference in the toxicological effects of *A. napellus* and *A. ferox* depends entirely upon the relative amount of aconitine contained in the two plants respectively, and not, as hitherto supposed, upon any difference in the virulence of the active principle of either of them.

6. Aconitine and pseudoaconitine are the strongest known poisons.

7. The maximum dose to be given at one time would be 0·1 m.g. or 0·5 m.g. per diem. Subcutaneously, the dose should be less.

8. Aconine and pseudoaconine, which are probably either identical or homologous, are likewise poisonous, but far less so than their mother alkaloids.

9. Benzoylaconine and veratroylaconine show an interesting chemical and pharmacological analogy to the alkaloids of the atropine group.

10. The aconitine of commerce is either benzoylaconine or veratroylaconine in a greater or less degree of purity; the German and French preparations being benzoylaconine, the English (especially Morson's) veratroylaconine.

11. The cause of the difference in the physiological effects in the various aconitines of commerce depends chiefly upon the relative amount of alkaloidal products of decomposition (aconine or pseudoaconine) which they contain, and which do not occur only as such, but also in the form of intermediate products of decomposition of aconitine (amorphous alkaloids).

12. Pure aconitine should yield a *colourless* solution with concentrated sulphuric acid, which should not turn red on the addition of one or two drops of a concentrated solution of sugar; the yellow precipitate, formed by adding phosphomolybdic acid to solutions of aconitine, should dissolve in a few drops of ammonia without any blue colouration.

13. Pure aconitine yields no colour reactions, and those formerly suggested were due to impurities.

14. Hübschmann's napelline is no distinct alkaloid, but a variable mixture of aconitine and aconine.

15. Acolyctine and lycoctonine are not identical with aconine (pseudoaconine).

Aconitia Nitrate, Crystallised. Crystallised aconitine q. s.; nitric acid, sp. gr. 1·442, q. s. Saturate the nitric acid with the aconitine and evaporate. Voluminous crystals are easily obtained (from 'Formulæ for New Medicaments adopted by the Paris Pharmaceutical Society'). Owing to the decomposition which this alkaloid undergoes in the animal organism, as well as to its liability to decompose during the process of evaporation and exposure to the air, it often becomes extremely difficult, if not impossible, to obtain it in a separate state in conducting a *post-mortem* examination. The physiological effects seem to furnish the most prominent and characteristic evidence of its presence in such cases, or at any rate these may serve as a valuable guide to the toxicologist.

Uncrystallised aconitia is sometimes contaminated with delphinia, as well as with aconella, another constituent of aconite root. For the distinction of these see ALKALOIDS. One fiftieth of a grain of aconitia is stated to have killed a dog.

Prep. Of pure aconitine, an ointment containing 8 grains in an ounce of lard.

Antidotes. See ACONITE.

ACONITIC ACID. (Identical with *Pyrocitric Acid.*) An acid extracted by Peschier from *Aconitum napellus,* and by Braccannot from *Equisetum fluviatile.* It exists in these plants chiefly in the form of aconitate of calcium.

Properties. A white, colourless, semicrystalline mass.

ACONITINA. See ACONITIA.

ACONITINE. See ACONITIA.

ACONI'TUM. [L.] Aconite. The Pharmacopœial name of *Aconitum napellus.* (See *below.*)

Aconitium Ferox. (Ind. P.) *Habitat.* Temperate and sub-Alpine Himalaya, at 10,000 to 14,000 feet elevation, from Gurhwal to Sikkim.

Officinal part. The dried root (*Aconiti ferocis radix*), in common with those of other Himalayan species, viz. *Aconitum napellus, A. palmatum,* and *A. luridum,* constitutes the drug well known in the bazaars of Upper India under the Hindostani name of *Bish* or *Bikh.*

It occurs in the form of tuberous roots of a more or less conical form, from two to three inches in length, and from half an inch to one inch in thickness at their upper end. They have usually a shrunken appearance, and are covered with a dark, shrivelled bark; fracture shining and resinous; sometimes waxy, varying in colour from pale to deep brown. Some specimens are white and spongy; and these, it is asserted, are superior in activity to the more compact kinds. Inodorous; taste at first slightly bitter, leaving a peculiar sense of numbness on the tongue and fauces. Active principle, aconitia.

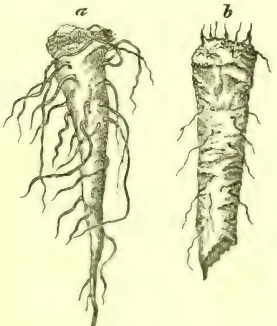
Medical Properties and Uses. Similar to those of *Aconitum napellus* of Europe.—*Preparations.* This root may be advantageously used for the manufacture of aconitia, the proportion of this alkaloid being much larger than in the European drug; and also for the preparation of Linimentum Aconiti. From its greater activity, however, it is unsuited for the preparation of the tincture, which is intended for internal use.

Aconitum Fischeri. Japanese aconite. The plant bearing this name has been recognised as *A. lycoctonum,* bearing yellow flowers. The roots only are found in commerce; they are generally firmer, paler in colour, smoother, and more acrid to the taste than the roots of *A. napellus.* The roots yield an alkaloid called japaconitine. A European variety of the plant contains two alkaloids, lycaconitine and myoctonine, both of which are powerful poisons.

Aconitum Heterophyllum. (Ind. P.) *Habitat.* Western temperate Himalaya, at 8000 to 13,000 feet elevation; from Indus to Kumaon.—*Officinal part.* The dried root (*Aconiti heterophylli radix*). Ovoid tuberous roots, tapering downwards to a point, from one to one and a half inches or more in length, and from three eighths to half an inch in thickness. The surface, which is covered with a thin greyish epidermis, is slightly wrinkled longitudinally, and marked here and there with root scars. It is inodorous, and of a bitter taste, devoid of acridity. Does not contain aconitia. It may be readily distinguished from other roots sold in the bazaars under the same vernacular name (*Atis*) by its characteristic bitterness.—*Properties.* Tonic and antiperiodic. It may be administered internally with safety, as it contains no poisonous principle.—*Therapeutic Uses.* In convalescence after debilitating diseases, and in intermittent and other paroxysmal fevers, it has been found an efficient remedy.—*Doses.* Tonic, 5 to 10 gr. thrice daily; antiperiodic, 20 to 30 gr. of the powdered root every 3 or 4 hours irrespective of the presence of pyrexia.

Aconitum Napell'us. [Linn.] *Syn.* ACONI'TUM, Ph. L., E., & D.; ACONIT NAPÈL, CHAPERON DE MOINE, Fr.; EISENHUT, BLAUERSTURMHUT, Ger. Early blue wolfsbane, or deadly aconite.—*Hab.* Various parts of Europe; grows wild in England, flowering in June and July. The fresh and dried leaves (ACONITI FO''LIUM), Ph. L. & E. The root (ACONITI RA'DIX) Ph. L. & D. This is the species of aconite ordered in the pharmacopœias, and commonly used in medicine. When chewed it imparts a sensation of acrimony, followed by a pungent heat of the lips, gums, palate, and fauces, which is succeeded by a general tremor and chilliness. The juice applied to a wound or the unsound skin affects the whole nervous system. Even by remaining long in the hand, or on the bosom, it produces unpleasant symptoms. Fatal cases of poisoning, by eating the root in mistake for horseradish, have been common of late years. The two roots may be however, easily distinguished from one another; when scraped aconite emits an earthy, and horseradish its well-known pungent odour. Moreover, the shape of the roots is very different. In the accompanying figure *a* represents aconite root and *b* horseradish root.

a *b*



The leaves should be gathered as soon as the flowers appear. The root should be taken up in autumn. When the whole plant is employed it should be gathered as soon as the flowers begin to open. The strength (richness in aconitia) varies considerably with the time of the year. 1 oz. of the fresh root contains $\frac{1}{4}$ to $\frac{3}{4}$ gr. of aconitia; 1 lb.

of the dried English root contains from 12 to 36 gr. (*Herapath*). The leaves possess the greatest activity just before flowering; the root, after it. The root is at all times fully six times as strong as the leaves or herb. The wild plant contains much more aconitia than that which is cultivated. The herb, and all its preparations, lose their efficacy if long kept. The powder, more particularly, cannot be relied on. Mr Holmes says it is difficult to find in a commercial sample of aconite root one root in a dozen, which upon fracture appears sound and in good condition.

Properties, Antidotes, &c. See ACONITE.

Tests, &c. See ACONITE.

Uses, &c. In small doses aconite is narcotic, powerfully diaphoretic, and sometimes diuretic; in larger ones, the symptoms are similar to those produced by aconitia. It acts as a powerful sedative on the heart's action, and destroys sensibility without disturbing the mental faculties. It has been given in chronic rheumatism, gout, paralysis, scirrhus, scrofula, cancers, venereal nodes, epilepsy, amaurosis, intermittents, &c.; but its exhibition requires the greatest possible caution. As a topical benumber it has been used with great advantage in painful affections depending on increased sensibility of the nerves. Externally it "is most valuable for the cure of neuralgia and rheumatic pains. In neuralgia, no remedy, I believe, will be found equal to it. One application of the tincture produces some amelioration; and after a few times' use, it frequently happens that the patient is cured. In some cases, the benefit appears almost magical. In others, however, it entirely fails to give permanent relief." "I do not think that in any (case) it proves injurious." "When it succeeds, it gives more or less relief at the first application. When the disease depends on inflammation, aconite will be found, I think, an unavailing remedy." "In rheumatic pains, unaccompanied with local swelling or redness, aconite is frequently of very great service." (*Pereira*, iii, 691.) *Dose*, of the powder, 1 to 2 gr., gradually increased to 6 or 8. Dr Stoerk was the first who gave wolfsbane internally, about the year 1762. It has since been successfully employed in Germany in cases of chronic rheumatism, gout, &c., some of which were of long standing and had resisted every other remedy. In England it has been less extensively used.

Aconitum Panicula'tum. Panicled wolfsbane; a species formerly ordered in the Ph. L.; and, with *A. napellus*, also in the Ph. U. S. It is less active than the officinal species.

A'CORN. *Syn.* GLANS. QUER'CUS, L. The seed or fruit of the oak. In the early ages of the world, acorns probably formed one of the principle articles of the food of man. (Ovid, *Met.*, i, 106; Virgil, *Georg.*, i, 8; &c.) In modern times, during periods of scarcity, they have been consumed as food on the Continent. Besides starch, they contain a peculiar species of sugar, which crystallises in prisms, and is unfermentable. Mannite and dulcose are the substances which it most nearly resembles. (*M. Dessaignes.*) They also contain tannic and gallic acids. During the autumn, acorns are said to be sometimes poisonous to cattle and sheep. Supposed cases of so-called acorn poisoning are best treated by withdrawing the supply of acorns, or removing the animals from the pastures on which the acorns fall, and by the administration of aperients, alkalies, and stimulants.

AC'ORUS CAL'AMUS. See SWEET FLAG.

ACOTYLE'DONS (-ko-te-lē'-). *Syn.* ACOTYLE'-DONES (-dŏn-ēz; L., prim. Gr.), Jussieu; ACOTYLÉDONS, Fr.; OHNE SAMENLAPPEN, Ger. In *botany*, plants whose seeds are not furnished with distinct cotyledons or seed-lobes.

Acotyledonous or cryptogamous plants have no true flower, but the term asexual, once applied to them, is incorrect, as they possess organs, antheridia and archegonia, which perform the functions of the sexual parts of the flower. They produce no true seeds, but propagate by spores, mostly unicellular and consisting of granular matter enclosed in two or more membranes. The spores have no embryo, and consequently no cotyledonary body, hence the name acotyledons. See ACROGENS, CELLULARES, THALLOGENS, &c.

ACOUS'TICS (-kow'-; from the Greek ἀκούω = to hear). That branch of natural philosophy which treats of the nature of sound and the laws which govern its production and propagation, in so far as these depend on physical principles.

ACQUETTA. [IT., *Little Water.*] *Syn.* AQUA TOFFANA; A. TOFFANIA; ACQUETTA DI NAPOLI DELLA TOFFANA, It. A celebrated poison, prepared by an Italian woman named Toffano, or Tophana, and in great request in Rome about the middle of the 17th century. The composition of this poison has been a matter of frequent controversy. Pope Alexander VII, in his proclamation, described it as "aqua-fortis distilled into arsenic." This would produce a concentrated solution of arsenic acid. The Emperor Charles VI, who was governor of Naples during Toffano's trial, declared to his physician, Garelli, that it was arsenic (arsenious acid) dissolved in *aqua cymbalariâ*. According to Gerarde this cymbalaria was an aquatic species of pennywort, highly poisonous. The only objection to the latter statement is the smallness of the dose, regard being had to the comparative insolubility of arsenious acid; but if the woman Toffano prepared two poisons, as is probable from history—one, a single dose of which was fatal, and another, of which the dose required repetition, and which was more gradual in its activity—the discrepancy will be at once removed.

AC'RID. *Syn.* AC'ER, AC'RIS, L.; ACRE (âcre), Fr.; BEISSEND, SCHARF, Ger. In *chemistry* and *medicine*, sharp, pungent, acrimonious. Acrid substances are such as excite a sensation of pungency and heat when tasted, and which irritate and inflame the skin; as mustard, turpentine, cantharides, &c.

ACRIDITY. *Syn.* ÂCRETÉ, Fr.; ACRITUDO, L. The quality of being acrid.

AC'RIMONY. *Syn.* ACRIMO'NIA, L.; ACRIMONIÉ, ACRETÉ, Fr.; SCHARFE, Ger. In *medicine* and *chemistry*, the quality or property of inflaming, irritating, corroding, dissolving, or destroying other bodies.

ACROGENS. *Syn.* ACROGENÆ, L.; ACROGÈNES, Fr. In *botany*, acotyledonous or cryptogamic plants, in which stems and leaves, or an organisation approaching leaves, are distinguish-

able; which have stomates or breathing pores on their surface, are propagated by spores, and increase by the growth of the stem at the point only. Ferns and club-mosses are examples of this class of plants.

ACROLEIN. *Syn.* Acrylic Aldehyde, C_3H_4O, or $CH_2=CH-CHO$. B. Pt. 52° C. (125·6° F.). This compound, the aldehyde of allyl alcohol, is obtained by the oxidation of the latter, and also by the dehydration of glycerine; it is therefore always produced in the destructive distillation of fats and oils (ethers of glycerine), the smell of burning fat being due to it. It is best prepared by distilling glycerine with acid sulphate of potassium, $KHSO_4$. It readily undergoes oxidation into acrylic acid, $C_3H_4O_2$. Its vapour possesses a most irritating odour, and attacks the mucous membrane of the eyes violently.

AC'ROSPIRE (-spire). *Syn.* Acrospi'ra, L.; Plumule, Fr.; Blattkeim, Ger. The shoot or sprout of a seed, when it begins to grow; the part of a germinating seed termed the plume or plumule. See Germination and Malting.

ACTINIC RAYS. See Actinism.

ACTINISM. *Syn.* Actinic Rays; Chemical Rays. A term given to a supposed principle accompanying the heat and light of the sunbeam. Actinic rays chiefly exist beyond the violet extremity of the solar spectrum, and are characterised by the power of exciting chemical change, *e.g.* the decomposition of certain silver salts (in photography); the combination of a mixture of chlorine and hydrogen, &c. The so-called vital functions of animals and plants are also greatly influenced by the actinic or chemical rays.

ACTINOGRAPH. An instrument for registering the intensity of the chemical influence (*actinism*) of the sun's rays.

ACTINOMETER. An apparatus used for gauging the actinic power of light. There are many forms of the instrument. The one most generally used in photography consists of a roll of sensitised paper enclosed in a box, in the lid of which is a small piece of glass. A little of the paper is unrolled and placed under the window in the lid, and exposed to light at the same time as the tissue (carbon process). When the paper has become of the same colour as the tint painted round the window a fresh piece is exposed, and so on until by trial and error the number of 'tints,' as they are called, required by a given negative in order to obtain the best print, has been determined. A record is kept of this, and the proper exposure can be given on any future occasion. See Photography.

ACTINOZOA. A group of animals, of which the most familiar examples are the sea-anemones and 'coral insects,' so called.

ACT, TOWNS IMPROVEMENT CLAUSES, 1847 (10 & 11 Vict., c. 34). The following provisions of this Act are incorporated in the Public Health Act, 1875, and refer exclusively to urban districts:

1. With respect to naming the streets and numbering the houses.

2. With respect to improving the line of the streets and removing obstructions.

3. With respect to ruinous or dangerous buildings.

4. With respect to precautions during the construction and repair of sewers, streets, and houses.

5. With respect to the regulation of slaughter-houses.

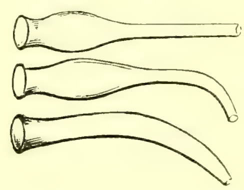
Notices for alterations under the 69th, 70th, and 71st sections, directions under the 73rd section, and orders under the 74th section of the said Towns Improvement Clauses Act, may, at the option of the urban authority, be served on owners instead of occupiers, or on owners as well as occupiers, and the cost of works done under any of these sections may, when notices have been so served on owners, be recovered from owners instead of occupiers; and when such cost is recovered from occupiers, so much thereof may be deducted from the rent of the premises where the work is done as is allowed in the case of private rates under the Act.

AC'TUAL. Real, effectual, absolute; as opposed to that which is merely virtual or potential. In *surgery*, a red-hot iron, or any other heated body, used as a cautery, is termed the actual cautery; whilst a caustic or escharotic so employed is called the potential cautery.

ACTUAL CAUTERY. See Actual.

ACUTE'. *Syn.* Acut'us, L.; Aigu, Fr.; Heftig, Hitzig, Spitzig, Ger. Sharp, pointed, sensitive. Applied to the senses, as acute hearing, eyesight, &c. In *pathology*, diseases exhibiting violent symptoms, and whose course is short, are said to be acute diseases.

ADAPTER. In *chemistry*, a tube placed between two vessels (commonly a retort and receiver) for the purpose either of uniting them or of increasing the distance between them so as to facilitate the condensation of vapour in distillation. See *figure*.



ADDER'S TONGUE. *Syn.* Common adder's tongue; Ophioglos'sum vulga'tum, Linn. A perennial plant of the natural order Filices (DC.), growing wild in England. It is found in our woods and pastures, and flowers in May and June. It was once used to form a celebrated traumatic or vulnerary ointment, and is still highly esteemed among rustic herbalists.

ADEPS. *Syn.* Lard. See Adeps præparatus, Fat, and Lard.

ADEPS BENZOATUS. *Syn.* Benzoated Lard.

ADEPS PRÆPARATUS. *Syn.* Axunge; Prepared Lard.

ADEPSINE. A variety of soft paraffin white or yellow in colour. Melting point about 120° F. It is used as an ointment base, and much resembles vaseline.

ADONIDIN. A bitter amorphous glucoside obtained from *Adonis vernalis*. Freely soluble in alcohol and water, only slightly in ether. Resembles digitalis in its action. *Dose*, ¼ to ½ gr. daily.

ADHE'SION (-hē-zhŭn). *Syn.* Adhæ'sio, L.; Adhesion, Fr.; Anhängung, Anklebung,

Ger. The act or state of sticking or being united.

Adhesion. In *physics*, the force with which bodies remain attached to each other when brought into contact; *e.g.* ink adheres to paper, paint adheres to wood, &c. It differs from 'cohesion' in representing the force with which different bodies cling together; whereas cohesion is the force which unites the particles of a homogeneous body with each other, *e.g.* particles of iron cohere and form a mass of iron; particles of water cohere and form a mass of water, &c.

Adhesion. In *pathology*, the morbid union, from inflammation, of parts normally contiguous but not adherent.

Adhesion. In *surgery*, the reunion of divided parts, by the adhesive inflammation; as when incised wounds heal by what is termed the 'first intention.'

ADHE'SIVE. *Syn.* ADHÆSI'VUS, L.; ADHESIF, Fr.; ADHÄSIVE, VERWACHSEND, Ger. In *pharmacy*, &c., having the quality or property of sticking or adhering. Hence adhe'siveness.

AD'IPOCERE (-sēre). *Syn.* GRAVE-WAX; ADIPOCE''RA, L.; ADIPOCIRE, Fr.; FETTWACHS, Ger. A substance resembling a mixture of fat and wax, resulting from the decomposition of the flesh of animals in moist situations, or under water. It is chiefly margarate of ammonium. Lavoisier proposed to produce this substance artificially for the purposes of the arts. Attempts have since been made to convert the dead bodies of cattle (carrion) into adipocere, for the purposes of the candle-maker and the soap-boiler, but without success.

Hatchettine or rock-fat is sometimes called 'adipocere'; and bog-butter is a substance very similar to it.

AD'JECTIVE. *Syn.* ADJECTI'VUS, L.; ADJECTIF, Fr. In *dyeing*, depending on another, or on something else; applied to those colours which require a base or mordant to render them permanent. See DYEING.

AD'JUVANT. [Eng., Fr.] *Syn.* AD'JUVANS, L.; AIDANT, &c., Fr. Assistant; helping. (As a substantive—) In *prescriptions*, see PRESCRIBING (Art of).

ADULTERATION. Strictly speaking, this term ought only to be applied to the practice of adding substances to articles of commerce, food or drink, for the purposes of deception or gain, but a wider interpretation is frequently placed on the word than the definition given by magistrates and analysts, these latter often regarding accidental impurity, or even, in some instances, actual substitution as acts of adulteration.

The following definition of an adulterated substance has been adopted by the Society of Public Analysts—

A substance shall be deemed to be adulterated—

A. *In the case of food or drink:*

1. If it contain any ingredient which may render such article injurious to the health of a consumer.

2. If it contain any substance that sensibly increases its weight, bulk, or strength, or gives it a fictitious value, unless the amount of such substance present be due to circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or unless the presence thereof be acknowledged at the time of sale.

3. If any important constituent has been wholly or in part abstracted or omitted, unless acknowledgment of such abstraction or omission be made at the time of sale.

4. If it be an imitation of or sold under the name of another article.

B. *In the case of drugs:*

1. If when retailed for medical purposes under a name recognised in the 'British Pharmacopœia' it be not equal in strength and purity to the standard laid down in that work.

2. If when sold under a name not recognised in the 'British Pharmacopœia' it differs materially from the standard laid down in approved works on materia medica, or the professed standard under which it is sold.

Limits. The following shall be deemed limits for the respective articles referred to:

Milk shall contain not less than 9·0 per cent., by weight, of milk solids, not fat, and not less than 2·5 per cent. of butter fat.

Skim Milk shall contain not less than 9·0 per cent., by weight, of milk solids, not butter fat.

Butter shall contain not less than 80 per cent. of butter fat.

Tea shall not contain more than 8·0 per cent. of mineral matter, calculated on the tea dried at 100° C., of which at least 3·0 per cent. shall be soluble in water, and the tea as sold shall yield at least 30 per cent. of extract.

Cocoa shall contain at least 20 per cent. of cocoa fat.

Vinegar shall contain not less than 3 per cent. of acetic acid.

The practice of fraudulent adulteration has been indulged in for centuries. In every civilised state there have been enactments against it. The Romans had their inspectors of meat and corn. In England an Act to prohibit adulteration was passed as early as 1267, and penalties against it were in force in 1581, 1604, 1836, 1851. In 1822, Accum published a work having the sensational title of 'Death in the Pot,' and in 1855 appeared Dr. Hassall's book, 'Food and its Adulterations.' The information conveyed in these works, added to the revelations of the 'Lancet' Sanitary Commission, and the contributions to scientific literature on the subject of food by Letheby, Pavy, Parkes, Blyth, and others, together with the published evidence given before the House of Commons Commission appointed to carry out an inquiry into the subject, roused public attention to such a degree as to lead to the passing by the Legislature of the Adulteration Acts.

The sophistications may be divided into several distinct classes:

1. To give weight or volume, such as water added to butter, plaster of Paris to flour, &c.; red earths to annatto, sand to tea leaves, &c.; water to milk, &c.; all these, therefore, are substitutions of worthless or very cheap articles which take the place of the real.

2. To give a colour which either makes the article more pleasing to the eye, or else disguises an inferior one, *e.g.* Prussian blue, black lead, &c.,

to green teas; annatto to cheese, &c.; arsenite of copper to sweetmeats, &c.

3. Substitutions of a cheaper form of the article, or the same substance from which the strength has been extracted put in the place of the real, *e.g.* spent leaves mixed with tea, &c.

4. A very small class where the adulteration is really added with no fraudulent intent, but to enhance the quality of the goods sold—alum to bread in small quantities.

The following, according to Blyth ('Dic. of Hygiène'), is a list of articles most commonly adulterated, with the names of the substances used in their sophistication:

ACONITIA with other alkaloids, *e.g.* delphinia, aconella, &c.

ALE, common salt, *Cocculus indicus*, grains of paradise, quassia, and other bitters, sulphate of iron, alum, &c.

ALLSPICE, mustard husks.

ANCHOVIES, other fish, and colouring matters, *e.g.* Armenian bole, Venetian red, &c.

ANNATTO, all sorts of starch, soap, red ferruginous earths, carbonate and sulphate of lime, salts, &c.

ARROWROOT, various other fecula, such as sago, tapioca, potato, and others.

BALSAM OF COPAIBA, turpentine and fixed oils.

BEEF (POTTED), Armenian bole.

BISMUTH, carbonate of lead, sometimes arsenic (this latter is an impurity not intentional).

BLOATERS (POTTED), Armenian bole.

BRANDY, water, burnt sugar, &c.

BREAD, potatoes (mashed), alum, inferior flour, &c.

BUTTER, water, salt, colouring matter, lard, tallow, and other fats.

CAJUPUT OIL, copper, camphor dissolved in oil of rosemary, and coloured with copper as a substitute.

CALAMINE, coloured sulphate of baryta.

CALOMEL, sulphate of baryta, chalk, white precipitate, white lead, pipe-clay, &c.

CALUMBA, tinged bryony root, root of *Frasera Walteri*, and others.

CAMBOGE, starch, &c.

CAMPHOR, a substitution of Borneo camphor has been made.

CANTHARIDES, golden beetle, artificially coloured glass, &c.

CARBONATE OF LEAD, sulphate of baryta, sulphate of lead, chalk, &c.

CARMINE (COCHINEAL), sulphate of baryta, bone black, &c.

CASSIA (SENNA), leaves of *Solenostemma argel*, and other foreign leaves.

CASTOR OIL, other oils, often small quantities of croton oil.

CAYENNE, ground rice, vermilion, Venetian red, turmeric.

CHAMPAGNE, gooseberry and other wines as substitutes, different colouring matters, &c.

CHEESE, annatto, bole (Armenian), and other colouring matters.

CHICORY, colouring matters, such as ferruginous earths, and burnt sugar, Venetian red, &c., and different flours, such as wheat, rye, beans, &c., and sometimes sawdust.

CIDER, lead (as an impurity, not intentional).

CIGARS, substitutions of hay and other rubbish, inferior tobacco, leaves sometimes darkened by some brown vegetable dye.

CINNAMON, cassia, clove stalks, and different flowers.

CLARET, brandy, and substitution of inferior wines.

CLOVES, clove stalks.

COCOA AND CHOCOLATE, cheaper kinds of arrowroot, such as *Tous les mois* and East Indian, animal matter, corn, sago, tapioca, &c.

COD-LIVER OIL, other oils mixed with it.

COFFEE, chicory, roasted wheat, rye flowers, roasted peas and beans, and colouring matters, such as burnt sugar, &c.

COLOCYNTH (COMPOUND EXTRACT OF), the extract is not unfrequently made with the pulp and seeds.

CONFECTIONERY, injurious colouring matters, such as arsenite of copper, chromate of lead, &c.

CONFECTION, AROMATIC (AROMATIC CHALK POWDER), expensive ingredients omitted, turmeric substituted for saffron, &c.

COPAL, gum dammar, resin, &c.

CURRY-POWDER, red lead, ground rice, salt.

CUSPARIA BARK, the bark of *Strychnos Nux Vomica* is said to have been substituted.

CUSTARD AND EGG POWDER, turmeric, chrome yellow, and different flours.

ELATERIUM, starch, flour, chalk, &c.

EPSOM SALTS, chloride magnesium, chalk, &c.

ETHER, alcohol.

FLOUR, other and inferior flours, as the flour from rice, bean, Indian corn, potato, &c., sulphate of lime, alum.

GELATINE, salt and sugar.

GIN, water, sugar, capsicum, flavouring matters of different kinds, turpentine, alum, tartar.

GINGER, turmeric, and husks of mustard, flour from wheat, sago, &c.

GUAIACUM RESIN, other resins.

HONEY, flour, cane sugar, &c.

HOPS, *Cocculus indicus*, grains of paradise, &c.

IODIDE OF POTASSIUM, water, carbonate of potash, chlorides of soda and potash, iodate of potash, &c.

IODINE, water, plumbago, charcoal, black oxide of manganese, &c.

IPECACUANHA, other roots, extraneous woody fibre; when in powder, chalk, flour, &c., have been added.

ISINGLASS, gelatine.

JALAP, raspings of guaiacum, false jalap root, &c.

LARD, carbonate of soda, salt, potato, flour, and lime.

LEMON JUICE, a mixture of sugar and water, acidulated with sulphuric acid, has been substituted.

LIQUORICE, rice, chalk, gelatine, and different flours.

MAGNESIA } lime, carbonate of
„ SULPHATE } magnesia.

„ CARBONATE, lime, sulphate, &c.

MARMALADE, apple, or turnip pulp.

MERCURY, lead, tin, zinc, bismuth, &c.

„ GREEN IODIDE OF, red iodide of

Mercury, Red Oxide of, brick-dust, red lead, &c.

„ Ammoniated (white precipitate), chalk, carbonate of lead, plaster of Paris, &c.

Milk, water.

Mustard, turmeric, wheat flour.

Myrrh, gum bdellium, and other gum resins.

Oatmeal, barley flour, rubble.

Opium, stones, sand, clay, vegetable extracts, sugar, treacle, water, &c.

Pareira Root, different roots substituted.

Pepper, linseed meal, different flours, mustard husks, &c.

Pickles, salts of copper, acetate of copper.

Porter and Stout, sugar, treacle, water, and salt.

Potash, carbonate, sulphate, and chloride of potash, lime, iron and alumina.

Potash, Acetate of } sulphates and chlo-
„ Carbonate of } rides of potash.

„ Bicarbonate of, carbonate of potash.

„ Citrate of, sulphates of potash.

„ Chlorate of, chloride of potassium.

„ Tartrate of, tartrate of lime.

„ Nitrate of, sulphate or chloride of potassium.

Preserves, salts of copper.

Quinine, sulphate of lime, chalk, magnesia, cane-sugar, sulphate of cinchonine, &c.

Rhubarb, turmeric, and inferior varieties substituted for Turkey.

Rum, water, cayenne, burnt sugar.

Sago, potato flour.

Sauce, treacle, salt, cochineal, Armenian bole, and other colouring matters.

Scammony, chalk, starch, guaiacum, jalap, dextrin, &c.

Senega, guinseng, gillenia.

Senna, leaves of *Cynanchum argel.*

Sherry, sulphates of potash, soda, brandy, burnt sugar, &c.

Snuff, carbonate of ammonia, glass, sand, colouring matter, &c.

Soda, Bicarbonate, carbonate and sulphate of soda.

„ Carbonate, sulphate of soda.

„ Phosphate of, phosphate of lime.

Spices, colouring materials, substitutions, and different flours.

Squills (Powdered), wheat flour.

Sugar (Moist), sand, flour, &c.

Sulphur, sulphurous acid (as an impurity).

Sulphuric Acid, lead, water, arsenic, hydrochloric acid, &c.

Tapioca, inferior starches mixed with the pure tapioca.

Tea, sand, iron filings, exhausted tea leaves, foreign leaves; and in green teas, black lead, Prussian blue, China clay.

Tobacco, inferior tobacco, water.

Turmeric, yellow ochre, carbonate of soda, or potash.

Uva Ursi (Bearberry Leaves), leaves of red whortleberry, and others.

Vinegar, sulphuric acid, and metallic impurities.

Wines, water, jerupiga, bitartrate of potash, substitution of inferior wines, brandy, spirits, and various other matters.

Zinc, Oxide of, chalk, carbonate of magnesia.

Important and common adulterations will be found mentioned under each particular article.

The recent Acts of Parliament dealing with the adulteration of food and drugs are the following: The Pharmacy Act, 1868; Sale of Food and Drugs Act, 1875; Sale of Food and Drugs Amendment Act, 1879; Margarine Act, 1887.

Æ (ē). [L.] For words sometimes written with this initial diphthong, and not found below, see under **E**.

A'ER (ā'-ĕr). [L., prim. Gr.] Air.

A'ERATED (ā'-ĕr-rāte-ĕd). In *chemistry*, &c., impregnated with carbonic acid. See Alkali, Lemonade, Waters, Mineral.

AE''RIAL (ā-ēre'-e-ăl). Belonging to the air or atmosphere; produced by, consisting of, depending on, or partaking of the nature of the air.

AERIFICA'TION (ā-ĕr-e-). *Syn.* Aërifica'tio, L.; Aérification, Gazéification, Fr. In *chemistry*, the conversion of a body into gas.

A'ERIFORM (ā'-ĕr-). *Syn.* Aëriform'is, L.; Aériform, Gazéiforme, Fr. Luftformig, &c., Ger. In *chemistry*, air-like, gaseous.

AEROL'OGY. *Syn.* Aërolo'gia, L.; Aérologie, Fr., Ger. In *physics*, a discourse or treatise of the air. In *physiology* and *hygiène*, the doctrine of the air, more especially with regard to its salubrity and action on organised beings.

AEROM'ETER. *Syn.* Aërome'trum, L.; Aéromètrie, Fr. An instrument used in aërometry.

AEROM'ETRY. *Syn.* Aërome'tria, L.; Aérométrie, Fr.; Luftmesskunst, &c., Ger. In *chemistry* and *physics*, the art of measuring gases, and of determining their densities.

AERONAUT'ICS. *Syn.* Aéronautique, Fr. The art of sailing in, or of navigating the air. See Balloons.

AEROPHO'BIA. [L.] *Syn.* Aérophobie, Fr. In *pathology*, a dread of air (wind); a common symptom in hydrophobia, and occasionally present in hysteria and phrenitis.

AEROSTAT'ICS. *Syn.* Aérostat'ica, L.; Aérostatique, Fr. That branch of pneumatics which treats of air, and other elastic fluids, in a state of rest.

AEROSTA'TION. [Eng., Fr.] *Syn.* Aërosta'tio, L. The art of weighing the air; aërial suspension and navigation. See Balloons.

ÆRU'GO (ē-). [L.] The rust of brass, bronze, or copper; verdigris.

ÆSCULIN. $C_{15}H_{16}O_9$. A crystalline fluorescent substance existing in the bark of the horse-chestnut (*Æsculus hippocastanum*) and of other trees of the genera *Æsculus* and *Paria.* In the above-named sources Æsculin is associated with another fluorescent body called Pariin. Æsculin is sparingly soluble in water, imparting a beautiful blue fluorescence when viewed by reflected light; alkalies augment, acids destroy the colour.

Æ'THER. See Ether.

ÆTHE'REA (-thērē-). [L. pl.] Ethers.

ÆSTHET'ICS (ēz-). *Syn.* Æsthet'ica, L. Medicines or agents which affect sensation. See Anæsthetics and Hyperæsthetics.

Æ'THIOPS. See Ethiops.

AFFEC'TION. [Eng., Fr.] *Syn.* Affec'tio, L. In *pathology*, a term nearly synonymous with disease.

AFFINITY, CHEMICAL. *Syn.* Affinitas, L.; Affinité, Fr.; Verwandschaft, Ger. "Chemical affinity is that property of bodies in virtue of which, when brought into contact, they react on each other, forming new bodies. . . . . Nothing is known as yet about the nature of chemical affinity, nor has a satisfactory hypothesis been suggested concerning it" (*Ostwald*, in Watt's 'Dict. of Chem.,' 2nd edit., vol. i). The subject is a very complex one, and cannot be gone into here, but a word or two may be said with regard to the popular acceptation of the term.

If mercury and water be shaken up together, and the mixture then be allowed to settle, the mercury will fall to the bottom of the containing vessel, neither it nor the water having undergone any change. If, on the other hand, mercury and (excess of) iodine be rubbed together in a mortar, a bright scarlet powder will be produced, which is neither mercury nor iodine, but a chemical compound of the two, viz. mercuric iodide, HgI_2. In this case chemical combination has taken place between the mercury and the iodine, these two substances having what is called an 'affinity' for one another, thus:

$$Hg + I_2 = HgI_2.$$

Again, when chlorine gas is passed into a solution of potassium iodide, the chlorine displaces the iodine from its combination with the potassium, forming potassium chloride, thus:

$$KI + Cl = KCl + I.$$

Here the potassium is said to have a greater affinity for chlorine than it has for iodine.

Chemical affinity is exerted at very minute distances, and therefore substances must be (apparently) in contact in order that they may combine with one another. The affinity of one substance for another depends, further, on various conditions, the most important of which are the temperature, the pressure, and the relative masses of the elements or compounds in question. See Chemical Combination.

AFFUSION. In *chemistry*, the washing of a precipitate, &c., for the purpose of removing soluble matters. In *medicine*, affusion is of three kinds:

1. *Lotions*, which consist in washing a part of the body with a sponge or rag soaked in a liquid.

2. *Aspersions*, which consist in throwing a liquid, drop by drop, like rain, upon the body.

3. *Shower baths*, which consist in allowing a number of small streams of water to fall from a height upon the surface of the body. If the water fall from a considerable height affusion is then termed *douche* by the French.

AFTER-DAMP. *Syn.* Choke-damp. Carbonic acid gas resulting from explosion of air and fire-damp (light carburetted hydrogen) in coal mines.

AFT'ER-PAINS. Those following child-birth due to the contraction of the uterus. The only remedy is patience; they may, however, be frequently alleviated by small doses of morphia or Liquor Opii Sedativus. Heated cloths and warm fomentations are sometimes useful, particularly if assisted by moderate but sufficient pressure on the abdomen, by means of a broad bandage. They seldom follow with severity the first birth.

In animals rarely continue more than twenty-four hours, and as a rule, *i. e.* if normal, do not call for special treatment. When birth has been sudden and rapid they persist longer and are more severe. If the accesses of pain are frequent and acute and continue beyond twenty-four hours, the retention of some part of the fœtal membranes, or commencing inversion of the uterus, is to be suspected, an exploration should then be made in order to ascertain the cause and determine the remedies to be adopted. In ordinary cases where the after-pains are not increased by a special cause, the remedies used for the human subject will be found useful.

AFT'ER-WASH (wŏsh). In the art of the distiller, the liquor in the still after the spirit has been drawn over.

AGALA'CTIA. Absence of milk. Not uncommon in mares and cows, especially those which have not been bred from for a long time, or have had their firstborn late in life.

Treatment. Good food, and especially leguminous food, with aniseed and fennel or fennel seeds.

AGAR-AGAR. Japanese isinglass is derived from several algæ, especially *Spherococcus compressus*, *Gloiopeltis tenax*, *Gelideum corneum*, and *G. cartilagineum*. It occurs in European commerce either in transparent pieces two feet long and as thick as a straw, prepared in Singapore by steeping the algæ in hot water; or more frequently in yellowish-white masses about a foot long and an inch wide.

Uses. Employed for bacteria culture, also as a food for invalids, likewise as a dressing for silks and calico.

AG'ARIC. [Eng., Fr.] *Syn.* Agar'icum, Agar'icus, L.; Blätterschwamm, Pilz, Schwamm, Ger. In *botany*, a genus of fungi, of numerous species, embracing the mushrooms and champignons. Of these plants, some are edible, others poisonous. The term is also commonly applied to the boletus found on oaks (touch-wood), and on larches (male agaric). See Mushrooms.

Fly-agaric. *Syn.* Fly mush'room; Agar'icus musca''ria, Linn.; Amani'ta m. One of the most narcotic and poisonous of our fungi, producing, in small doses, intoxication and a pleasing species of delirium; for which purpose it is commonly employed in Kamschatka. (*Hooker.*) It possesses the singular property of imparting an intoxicating quality to the urine, which continues for a long time after taking it. This secretion is, therefore, commonly saved by the natives during a scarcity of the fungus. "Thus, with a few amanitæ, a party of drunkards may keep up their debauch for a week;" and the intoxication so produced is capable of "being propagated through five or six individuals." (*Langsdorff.*) Water in which it has been boiled is poisonous; but the boiled fungus itself is inert. The liquid from it is used as a fly-poison; whence the name mushroom is derived. It may be known by its rich orange-red colour in autumn.

AGARICIN. *Syn.* AGARICINUM. The active principle of *Agaricus albus* or *Polyporus officinalis.* It is a white crystalline powder, given in the night sweats of phthisis, also diarrhœa, to diminish bronchial secretion, and dry up milk after weaning.—*Dose,* $\frac{1}{12}$ to $\frac{1}{6}$ grain. See MUSCARIN.

AG'ATE (-āte). [Eng., Fr.] *Syn.* ACHA'TES (-kā'-tēz), L. From a river in Sicily, on the banks of which it is said to have been found. Agate consists chiefly of calcedony with mixtures of common quartz and occasional patches of jasper and opal. Its composition is not uniform, but it usually contains 70 to 96 per cent. of silica, with varying proportions of alumina coloured by oxides of iron and manganese.

The principal varieties are:

Calcedony. A porous stone with colours arranged in parallel bands. This variety is converted into artificial onyx at Oberstein in Germany, by immersion in a solution of honey in water, kept hot in an oven for two or three weeks, subsequent washing, drying, and treatment with sulphuric acid.

Carnelian, or red calcedony.

Mocha Stones. Clear grey calcedony.

Moss Agates. Stones containing tree-like markings of oxide of iron.

Blood Stones. Dark green with red spots.

Plasma. A grass green stone, used in some ancient intaglios.

Chrysoprase. Found in Silesia, is an agate coloured by oxide of nickel.

AGEING LIQUOR. Dissolve 3 lbs. of chlorate of potash in 4 galls. of boiling water. Add 20 lbs. of powdered white arsenic to 20 lbs. of solution of caustic soda at 60° Tw., and boil until the arsenic is completely dissolved. Add the latter solution to the former, with stirring, until the mixture stands at 28° Tw.

AG'NAIL. See WHITLOW.

AGNINE. A substance similar to lanoline, which *see.*

A'GUE (-gū). *Syn.* MALARIAL FEVER, MALARIA, MARSH FEVER, PALUDAL FEVER, INTERMITTENT FEVER. FIÈVRE INTERMITTENTE, Fr.; WECHSELFIEBER, KALTEFIEBER, Ger.

Definition. The disease, or rather group of diseases comprised under the above names, is difficult to define in such a way as to include all its various forms.—A simple ague has the following characteristics: A cold or shivering stage, with more or less pronounced rigors; a hot and febrile stage, and a sweating stage. This succession of phenomena may, and often does, manifest itself in cases of severe cold. The remarkable characteristic of agues is their repetition at exceedingly regular intervals of time, and according to the duration of the period of intermission agues are classified as *quotidian* when the attacks occur daily; *tertian* when they occur every other day; *quartan* when there is an interval of two days between the attacks. Combinations of these intervals may occur, resulting in double quotidian, double tertian, &c., and these insensibly pass, on the one hand, into continuous or almost continuous fever (pernicious) and very irregular types in which the intervals between the attacks are prolonged and uncertain. By *intermittent fever* is understood a fever with intermissions, during which the temperature of the body returns to the normal. In *remittent fever* there is a marked lowering of the temperature at regular intervals, but there is always a constant residue of fever, and the temperature does not reach the normal limit in the intervals. For many reasons which cannot be entered upon here, we are justified in regarding intermittent and remittent fevers as degrees of intensity of manifestation of one and the same disturbance of the animal economy.

Distribution. Relation to Water and Temperature. Malarial fevers are the most widely distributed and, perhaps, the most disastrous in their effects of any disease to which mankind is liable; they have been and still are *par excellence* the enemies of explorers and colonists in tropical and subtropical climates; and it is of the utmost importance that such persons should possess some knowledge of their distribution, the characters of localities in which they prevail, and such means of guarding against them, or treating them when they occur, as experience has taught us to be practically useful.

Malarial fevers are essentially a disease of tropical and subtropical climates. They are most intense in the tropics, and disappear as we approach the poles; hence we may argue a relation of the disease to temperature. A careful examination of the areas most affected shows that the estuaries and deltas of rivers, low-lying land liable to flood, and wet, undrained, boggy districts are the most frequent haunts of the disease; and this well-recognised connection with water has given rise to the terms marsh fever and paludal fever. Wider experience and more careful investigation have shown that the supposed universal connection between malaria and marshy land does not exist, and that, on the one hand, there are large areas of marsh where fever is unknown, and on the other, vast tracts of country to which the term marshy would in no sense apply, which are all but uninhabitable in consequence of the severity of the fever prevailing in them. The relation to water, however, is not thus done away with, for in all these cases of apparent absence of the conditions of a marsh, the subsoil drainage is, as a rule, either non-existent or extremely defective, and for various reasons, such as the nature and constitution of the soil, position and direction of strata, the subsoil water is retained and the soil really, though not apparently, waterlogged. The Roman Campagna affords an excellent example of this state of affairs. So far the relation of malaria to temperature and water would seem to be established; unfortunately there are localities in South America, India, China, and other tropical countries where these fevers prevail in their very worst forms and which are characterised by an all but complete absence of water. The subsoil does not exist and is replaced by hard impermeable rock so scantily covered with soil that cultivation is well-nigh impossible. Thus the *direct* relation of water to the disease becomes doubtful, and the one universal factor left is temperature.

Relation to Altitude. Malarial fevers diminish in intensity from the equator to the poles, and also with altitude, it is practically true that the

higher we ascend above the sea level in a malarious country, the less is the risk of acquiring the disease; and it would appear that the only qualification of this statement which is necessary is the elimination of closed valleys at high altitudes, and certain rocky soils possessed of a special capacity for absorbing and radiating heat. The direct elevation above the soil necessary to afford substantial protection to the inhabitants is very small, as the custom in malarious countries of building houses on the tops of tombs and on scaffolds and the use of the upper parts of houses only, as dwelling-rooms, abundantly testifies. In the Roman Campagna there are innumerable instances of houses built on hillocks some 20 or 30 feet above the surrounding country, in which the inhabitants enjoy considerable immunity from the disease; whereas, did they live on the level they would imperil their health, if not their lives. Altitude then is a most important factor in the ætiology of malarial fevers.

Relation to Cultivation. The relation of malaria to cultivation has, until comparatively recently, been involved in considerable obscurity, owing to the apparent conflict of evidence on the subject. The relationship would appear to be twofold, *general* and *local.*

General. Cultivation of all kinds, and especially the planting of trees, has an enormous and well-recognised influence upon climate. The cutting down of forests in mountainous countries by denuding the soil allows the rain water to run off rapidly and without restraint, carrying with it earth, stones, and rubbish; small mountain streams are converted into resistless torrents, with the result that the lowlands are at irregular and uncertain intervals deluged with water, carrying mud and stones, far beyond the capacity of the natural drainage to dispose of, crops are destroyed, and large areas of cultivable land converted into bog or stony wastes; whereas, when the mountain forests are carefully preserved they act as storehouses for water, and supply it in constant and reasonable quantity to the plains. The reckless destruction of forests in Italy has brought about the most disastrous results in this way, and the present state of the Pontine region is largely to be attributed to this cause. The destruction of woods and forests on the plains operates in another direction. The storehouses of water are destroyed, the climate altered, and instead of a seasonable and equable temperature, the country becomes subject to violent extremes of heat and cold, and the land will no longer yield either good pasture or grain crops. Agriculture is neglected, and unless there be some other powerful agency at work to counteract it, such a country very soon is deserted by its inhabitants, and becoming more and more a desert, nature is left to her own devices, and malaria is only too likely to make its appearance.

Local. There are innumerable instances throughout the world of virgin forests filled with a dense undergrowth which are notoriously malarious. The mere presence of trees is therefore no safeguard against malaria, and may under such circumstances be considered a direct cause. There is no evidence, however, that well-regulated forests ever act in this way, but on the contrary much in favour of their value as a means of eradicating the disease. The method of their action is probably very simple; if well ventilated and properly cared for they act as drainers of the subsoil, and this especially in those soils to which artificial drainage is scarcely applicable, from their highly absorbent nature; this is particularly the case in the Roman Campagna, where the water-holding capacity of the volcanic soil is almost incredible. General cultivation of course assists this movement of the water, but is only possible when the climate is controlled by trees, and protection afforded to the growing crops from winds, storms, and excessive variations of temperature. The idea that plantations of Eucalyptus have a specific action in destroying the malarial poison may be dismissed at once, as fever is common in the blue-gum forests of Queensland.

Irrigation in malarious countries is regarded as dangerous, and liable to increase the disease. There is much to be said in favour of this theory, but, inasmuch as the great examples of evil results following irrigation are cases in which the operation has been so carried out as to waterlog the subsoil, in fact cases of inundation rather than true agricultural irrigation, an obvious explanation presents itself. The Jumna Canal works, in India, appear to have had this result; the effect upon the health of the district has certainly been most disastrous, and, so far as can at present be judged, is entirely owing to waterlogging of the subsoil and consequent alteration of climate.

Season of the year has a most important influence upon the presence of malarial disease, so much so that in all malarious countries there is a more or less well-marked fever season. The periods of change from cold to hot and dry to wet are those in which these fevers attain their greatest intensity, for example, in the Roman Campagna the cessation of the spring rains and commencement of the summer heats is always marked by an increase of the number of cases of fever; as the heat and dry weather continue, they diminish again until the first rains of autumn begin to fall, when the true fever season begins. Three or four days' heavy rain during the great heat of the latter days of August will sometimes tax the resources of the Roman hospitals very severely. At this time of year the climate is very trying, and those exposed to it require to use great precautions in order to avoid its evil effects. The days are intolerably hot and the nights equally cold, the temperature falling after sundown with extraordinary rapidity. These sudden and violent changes of temperature appear to be almost characteristic of malarious countries, and there can be no doubt that subsoil water plays a very important part in their production, consuming vast quantities of heat in evaporation by day, and radiating it very rapidly at night, producing the peculiarly heavy dews which are common to these districts.

Population has a wonderful effect in diminishing malaria, and it may be said of any town situate in a malarious region that, other things being equal, the risk of acquiring the disease is least at the centre and greatest in the outskirts. As population increases, and the land becomes covered with streets and houses and their accompaniments—paving and drainage—the malaria is driven far-

ther and farther from the centre. The City of Rome affords a remarkable instance of this. The present fashionable quarter is built upon sites which at the time of the entry of the Italian troops in 1870 were notoriously unhealthy.

Effect of the Disease on the People. Though not necessarily a fatal malady, malaria produces the most disastrous effects upon the population it attacks. Their labour-producing capacity is diminished, and at the same time their numbers, so that unless recruited from the outside, the labour required to till the soil will ultimately be wanting, and the land must either go out of cultivation or be turned into pasture. Nor is the population diminished merely by the loss of those who fall victims to the disease. A malaria-stricken population is not prolific. Abortion is common, and the offspring feeble and unhealthy, and less able to resist the evil conditions to which it is exposed than the parents; further, there is a marked tendency to mental and moral degradation.

Ætiology of the Disease. The ætiology of malaria is one of the vexed problems of modern times. From time immemorial it has been attributed to the action of miasmata arising from marshes, and these miasmata have always been supposed to be minute organisms. During the last twenty years nearly as many different organisms have been described by various writers as the cause of the disease, and the labours of Klebs and Crudeli, Laveran, Celli, and Marchiafava, have done much to increase our knowledge of the changes set up in the organism by the malarial poison, the true nature of which must still be regarded as very far from settled. The proof that any organism yet discovered is the specific cause of intermittent fever is still very unsatisfactory, and there is much to be said for the view that it is a purely nervous disorder, caused by the break-down of the heat-regulating mechanism of the body under the violent climatic conditions to which it is exposed. The changes produced in the organs and tissues are often very slight; there is an undoubted disorganisation of the red blood-corpuscles, and a deposit of black colouring matter in certain parts of the body, especially in the minute blood-vessels of the brain. The spleen may be enormously enlarged, and the liver also to some extent, but in a very large number of cases it is very difficult to point to any definite changes produced by the disease.

Treatment. When once it has been determined clearly that a person is suffering from ague, *i. e.* true and well-marked intermittent fever, it is a golden rule never to give medicine *during* an attack, unless it be absolutely necessary. Quinine given about an hour before an attack commences will modify it, delay its development, or cause it to abort altogether, according to the dose and circumstances of the case; it is a little doubtful whether very large doses (20 to 40 gr.) of quinine produce a beneficial effect at all proportionate to the discomfort they cause to the patient; but there are cases in which it may be desirable to give them. Five grains of quinine with five drops of Liquor Arsenicalis (*Fowler*), taken three times a day, in the intervals between the paroxysms, will often produce most excellent results. Care should be taken to evacuate the bowels by means of a saline purge before commencing treatment with quinine, and in mild cases this simple remedy will often effect a cure. Plenty of good simple food, with red wine, should be taken in the intervals, and the patient's general strength kept up as much as possible. Under this treatment a bad double quotidian will become a mild tertian, and disappear, or a tertian may yield at once. Quartans are always obstinate and difficult to cure. Care should be taken not to remove the patient too soon to another climate, as this very frequently causes a return of all the symptoms, and a person who has once suffered from ague should be most careful never to expose himself to chills, and to wear a sufficiency of *woollen* clothing, especially woollen underclothing, to prevent his readily feeling changes of temperature.

Precautions to be taken in Malarious Countries. From what has been said above, avoidance of all exposure to sudden change of temperature is important, and, if the exposure be necessary, care should be taken to wear such clothing as will prevent these changes being felt. Good food, and plenty of it, an active life, and a moderate use of good red wine, or other pure alcohol, especially after exposure to chill, seem to be the best prophylactics. Malarious countries are usually very damp, and it is often desirable to have a fire, even in the heats of summer, for the purposes of ventilation and drying the air.

The occasional use of small doses of arsenic, one or two drops of Fowler's solution, three times a day after food, is useful before undergoing any special exposure; but this should not be allowed to degenerate into a habit, and should always be discontinued as soon as possible; it would also seem to be more effectual when taken at regular intervals, say three days at a time, and then discontinued for two or three days.

If compelled to pass the night in the open in a malarious country, it is an excellent plan to sleep between three fires, which, when burning brightly, have been fed with wet branches, so as to cause them to smoke and thus diminish radiation. Avoid sleeping on the ground; and if unprovided with the means of keeping warm, it is better not to sleep, but to keep in motion till sunrise, the object being to maintain the circulation in a state of activity, and so diminish the risk of chill. In choosing a place to camp, avoid the bottoms of valleys or damp slopes of hills; a well ventilated or elevated site, though colder, is preferable to a sheltered one if warm and damp. Excessive fatigue should at all times be avoided, and exposure to the sun, if unavoidable, should be discounted as far as possible by suitable clothing and head-gear, special care being taken to protect the back of the neck. The possibility of the malarial poison being carried by water appears to be very remote, but it is well to remember that bad water will set up diarrhœa and intestinal disturbance, and so diminish the resisting power of the individual, the fever often manifesting itself as an accompaniment of some other and perhaps insignificant disorder. Malarial poisoning frequently shows itself in this way, long after the subject of it has been removed from all possible sources of infection and when it was never supposed that the patient had acquired the disease.

Persons who have had intermittent fever are always liable to a return of it, and should be most careful of their general health, avoiding all circumstances likely to provoke an attack; for the disease is like a bad habit, practice makes it easier, and the longer it is kept off the less likely is it to return.

Ague-cake. The popular name of a tumour felt under the false ribs on the left side, formed by enlargement and induration of the spleen, following protracted ague; also, sometimes, of indurations of the liver following ague.

Ague-drop. See DROPS.

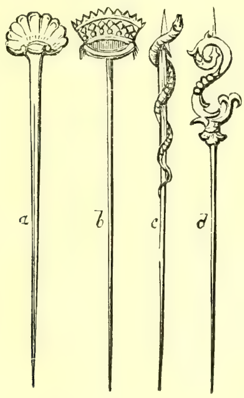
Ague-salt (sōlt). Disulphate of quinine.

Ague-tree. Sassafras.

Ague-weed. The herb thorough-wort (*Eupato''rium perfolia'tum*, Linn.).

AIG'REMORE (ĕg'r-mor). [Fr.] Pulverised charcoal in the state it is used to make gunpowder.

AIGUILLETTE (ATTELETTE). [Fr.] In



Attelettes from Soyer.

cookery, a term applied to several small dishes, from the articles of which they consist being mounted on silver needles, or skewers, with ornamental handles or tops. (See *engr.*) They form one of the varieties of the 'hors-d'œuvres' of Soyer; and are commonly served on a napkin. The skewers should be about four inches long, and of the thickness of an ordinary packing needle. The person eating what is served on them takes the head of the skewer between the thumb and fingers of the left hand, and picks it off with his fork. Those noticed by Soyer are—

Aiguillettes à l'Eperlan (*smelts*);

Aiguillettes aux Huitres (*oysters*);

Aiguillettes de Filets de Sole (*soles*);

Aiguillettes de Homard (*lobsters*);

Aiguillettes de Langue de Bœuf (*ox-tongue*);

Aiguillettes de Ris de Veau (*sweetbread of veal*);

Aiguillettes de Volaille à la Jolie Fille (*fowl*);—

all of which are prepared in a nearly similar manner, merely varying the sauces, &c., to suit the article and palate. See ATTELETTES, HORS-D'ŒUVRES, &c.

AILANTHUS. The inner bark of the *Ailanthus glandulosa*, a common tree growing in northern China, said by Dr Dudgeon to have proved very successful in dysentery.

The *Ailanthus glandulosa* is also well known throughout the United States. Professor Hétet, of Toulon, tried the effect of the powdered bark, leaves, and various preparations of the bark or drugs, with the result of their administration being attended with purgative effects and the discharge of worms.

The powdered bark has been given in small cases of tapeworm in the human subject, with marked success. The dose of the powder found sufficient for the expulsion of the tapeworm varied from seven or eight to thirty grains.

AIL'MENT. Pain, indisposition; disease. Its use is generally restricted to the non-acute, and milder forms of disease.

AIR. [Eng., Fr.] *Syn.* AER, L. (from ἀήρ, Gr.); LUFT, Ger.; ATMOSPHERIC AIR; THE ATMOSPHERE. The older chemists used the term *air* in much the same sense as the word *gas* is now employed; *e.g.* gaseous ammonia was called alkaline air; oxygen,—dephlogisticated, vital, or empyreal air; carbonic anhydride (carbonic acid), fixed air; hydrogen, inflammable air; heavy carburetted hydrogen, or olefiant gas, heavy inflammable air; nitrogen,—mephitic, phlogisticated, or nitrous air. At the present day the term air is restricted to the gaseous envelope which surrounds our globe, and at the bottom of which we live.

The proof that we do not live in empty space, but are enveloped in an invisible gas is of two kinds. Firstly, we are made conscious of resistance when we attempt to move rapidly through it; and secondly, air may be removed from a vessel containing it by means of a suitable pump, and thus be shown to have weight and volume. Further, it can be compressed or expanded by various means.

The weight of the atmosphere and its variations is a matter of very great importance, and its accurate observation affords us information of enormous value. See BAROMETER.

"Although some of the ancients, especially Vitruvius, appear to have held the view that the air possesses weight, yet it is to Torricelli that we owe the first distinct proof that this is the case. In the year 1640 a Florentine pump-maker found that his lift-pump could not raise water to a height greater than thirty-two feet, and consulted his great townsman Galileo as to the cause of the phenomenon. Galileo does not appear to have given the correct solution; as he compared the water column to an iron rod hung up at one end, which when long enough will at last break with its own weight. Torricelli, however, in 1643, made an experiment which gave the true explanation of the pump-maker's difficulty. Filling with mercury a glass tube three feet in length, and closed at one end but open at the other; he closed the open end with his finger, and inverted the tube in a basin filled with mercury. The mercury then sank in the tube to a given level, whilst above this level there was an empty space, which is still called the Torricellian vacuum. Above the mercury in the basin was water, and Torricelli then raised the tube so that the open end came into the water. The mercury then flowed out and

the water rushed up, completely filling the tube. The rise of mercury or water in a vacuous tube is caused by the pressure of the atmosphere; the water is, however, 13·5 times lighter than the mercury; hence the column of the former liquid, which is supported by the atmospheric pressure, is 13·5 times as high as that of the latter liquid" (Roscoe and Schorlemmer's 'Chemistry,' vol. i). The column of mercury being about thirty inches in height the equivalent weight of water in a tube of the same bore would rise to the height of 33·7 feet. The term *barometer* was first made use of by Boyle.

The absolute height of the atmosphere has not been ascertained with accuracy, and as the density diminishes as we ascend, it is almost impossible to say where the atmosphere ends. If the density were constant and equal to that at sea level, the height would be 8360 metres, or 5·204 Eng. miles. The volume increases for various heights above the earth's surface in the following ratios:

Geographical Miles.	Volume.
0·0	1
0·587	2
1·174	4
1·761	8
2·348	16
2·935	32
3·522	64

According to Regnault 1 litre of pure dry air at 0° C. and at the pressure of 760 mm. weighs 1·293201 gram.

The weight of air in our latitudes is equal to that of a column of mercury at 0° C. of the height of 760 mm. Hence as 1 c.c. of mercury weighs 13·596 grms., the pressure on one square centimetre would be $13·596 \times 76 = 1033·3$ grms. or nearly 15 lbs. on every sq. inch.

A further proof that the height of the barometer depends on the pressure of the atmosphere, is afforded by the fact that the barometer falls as we ascend a mountain; this was argued out by Blaise Pascal, and confirmed by his brother-in-law Perier, who took a barometer to the summit of the Puy de Dôme in the year 1648.

Composition. "Atmospheric air, in addition to oxygen and nitrogen, contains as normal constituents, aqueous vapour, carbon dioxide, ammonia, and ozone. Other gases and vapours do indeed occur in different places, under a variety of circumstances, and in varying quantities. Furthermore, certain chemical compounds, such as common salt, ammonium nitrate, and some other chemical salts, occur as finely divided solid particles, together with other minute floating particles of animal, vegetable, and mineral origin." (Roscoe and Schorlemmer, loc. cit., vol. i.)

In the year 1781, Cavendish discovered that atmospheric air contained 20·8 volumes of dephlogisticated air or oxygen, and 79·2 volumes of phlogisticated air or nitrogen in every 100 volumes, and that atmospheric air was of unvarying composition.

Although, doubtless owing to local conditions, trifling variations may occur in the proportion of oxygen present in the atmosphere, this variation is so trifling that the difference of the amount in air from places separated by very long distances will be found in the second decimal place only; thus, whilst a portion of air taken during a balloon ascent by Mr Green gave on analysis 20·88% by vol., Dr Frankland found in air collected by himself on the summit of Mont Blanc 20·96% by vol. A still nearer approximation in uniformity in the amount of oxygen present in atmospheric air is exhibited in the following table, which gives the results of 95 analyses by Regnault on air obtained from nine different localities:

100 from Paris gave in 100 parts, by vol. of oxygen .	20·913 to 20·999
9 from Lyons and around gave in 100 parts, by vol. of oxygen	20·918 to 20·966
30 from Berlin gave in 100 parts, by vol. of oxygen .	20·908 to 20·998
10 from Madrid gave in 100 parts, by vol. of oxygen .	20·916 to 20·982
23 from Geneva and Switzerland gave in 100 parts, by vol. of oxygen	20·909 to 20·993
15 from Toulon and Mediterranean gave in 100 parts, by vol. of oxygen . . .	20·912 to 20·982
5 from Atlantic Ocean gave in 100 parts, by vol. of oxygen	20·918 to 20·965
1 from Ecuador gave in 100 parts, by vol. of oxygen .	20·960
2 from Pichincha gave in 100 parts, by vol. of oxygen .	20·949 to 20·981
Mean of all foregoing . .	20·949 to 20·988
,, of the Paris specimens .	20·96

Carbonic Anhydride (*Carbonic Acid*). An important product of combustion, putrefaction, and fermentation, is always present in the air, varying, however, considerably with the locality. The air of towns containing more than that of the open country, a very pure air containing only about 0·03 volumes per cent. of carbonic anhydride.

The following table from Dr Angus Smith's work 'Air and Rain,' will give some idea of the extent of these variations under ordinary circumstances.

	Per cent.
Air of Madrid, outside the walls, mean of 12 analyses, by Luna	·045
Mean of 12 analyses, within the walls of Madrid, by Luna	·051
Mean of 14 analyses, by Angus Smith, in Manchester suburbs	·369
In Manchester streets	·403
Usual weather	·0403
During fogs	·0679

De Saussure's analyses show that there is more carbonic acid on the mountains than in the plains, as might be inferred from the comparative absence of vegetation in elevated positions. Dr Pietra Santa states that the air of hills or mountains, at the height of 2300 feet, is lighter than common air, contains a smaller proportion of oxygen, and is impregnated with a largely increased amount of aqueous vapour. It also

contains a large quantity of ozone. He considers such a climate peculiarly soothing to persons suffering from chest diseases.

Dr Angus Smith's analysis of the air from the mountainous districts of Scotland confirms the above statement of Dr Pietra Santa's. The heaths and mountains of that country are remarkably healthy localities, and the air from them gave on analysis 20·94% by vol. of oxygen, and only ·033 of carbonic acid.

The effect on the composition of the atmosphere produced by the respiration of a large number of persons in confined spaces is shown in the following table:

I. *The following tables exhibit the amount of carbonic acid in close places in London.*

	Per centage by volume.
Chancery Court, closed doors, 7 ft. from the ground, March 3	·193
Same, 3 feet from ground	·203
Chancery Court, doors wide open, 4 ft. from ground, 11.40, March 5	·0507
Same, 12.40 p.m., 5 ft. from ground	·045
Strand Theatre, gallery, 10 p.m.	·101
Surrey Theatre, boxes, March 7, 10.30 p.m.	·218
Olympic, 11.30 p.m.	·0817
Same, 11.55 p.m.	·1014
Victoria Theatre, boxes, March 24, 10 p.m.	·126
Haymarket Theatre, dress circle, March 18, 11·30 p.m.	·0757
Queen's Ward, St. Thomas's Hospital, 3.25 p.m.	·052
Edward's Ward, St. Thomas's Hospital, 3.30 p,m.	·052
Victoria Theatre, boxes, April 4	·076
Effingham, 10.30 p.m., April 9, Whitechapel	·126
Pavilion, 10.11 p.m., April 9, Whitechapel	·152
City of London Theatre, pit, 11.15 p.m., April 16	·252
Standard Theatre, pit, 11 p.m., April 16	·320

II. *London Air.—Carbonic Acid, Metropolitan Railway, November*, 1869.

Date.	Place.	Time of Day.	Carbonic Acid, per cent.	Oxygen, per cent.
1869. Nov. 12.	Tunnel between Gower Street and King's Cross Stations; specimen taken at the open window, first-class carriage.	10 a.m.	·150	20·60
„ 12.	Tunnel between Gower Street and King's Cross Stations; specimen taken at the open window, first-class carriage.	7.30 p.m.	·078	20·79
„ 12.	Tunnel Praed Street; specimen taken at the open window, first-class carriage.	10.30 a.m.	...	20·71
„ 15.	Specimen taken during journey between Gower Street and King's Cross, first-class carriage, window open.	10.15 a.m.	·338	20·66
„ 15.	Same	3 p.m.	·155	20·70
„ 15.	Same	11 p.m.	·150	20·74
	Average		·1452	20·70

ANGUS SMITH.

III. *The Air of Mines* (*Metalliferous*).

Name of Mine.	Description of place, where taken, and time when taken.	Thermometer. Fahr.	Number of Men working in it.	Oxygen, per cent.	Carbonic Acid, per cent.
Hurst	End, 300 ft. beyond a rise, 9 ft. high, 7 ft. wide.	...	2	...	1·99
Old Gang	End of level	...	2	20·58	·48
„	End of level	...	2	...	·28
„	(*a*) Rise 7 ft. high, 132 ft. from current	...	2	20·25	·39
Grassington	(*b*) End of cross cut, 480 ft. from rise	...	2	20·94	·06
„	End, 480 ft. from rise	...	2	19·53	1·59
„	Rise 60 ft. high in shale	...	2	19·52	1·72
„	End, 60 ft. from rise.	...	2	20·47	1·06
„	End, 840 ft. from rise	...	2	20·08	·94

(*a*) Air machine. (*b*) Unusual amount of dust.

ANGUS SMITH.

Dr Angus Smith states that out of 339 specimens of air obtained from various mines he found 35 normal or nearly so, 81 decidedly impure, and 212 exceedingly bad; he also adds that owing to the frequent firing of charges of gunpowder within the mines, and from other causes, the atmosphere is further contaminated with sulphuretted hydrogen, sulphate, carbonate, sulphide, sulphocyanide, and nitrate of potassium, carbon, sulphur, carbonate of ammonia, organic matter, sand, and sulphurous and arsenious acids.

The air of large cities, which are the seats of manufacturing industry, is always more or less charged with the exhalations given off by chemical and other works. The sulphuric-acid works contribute sulphuric, sulphurous, nitrous, and arsenious acids; copper works, in which pyrites is employed, give off large quantities of sulphurous acid, mixed with arsenic and a little copper; manure works, in many cases, send out compounds of fluorine, besides sulphuric acid; glass works, sulphuric and hydrochloric acids; and alkali works, hydrochloric acid (although in small quantities), which very frequently contains arsenic. Of ammonia, Angus Smith remarks: "It is one measure of the 'sewage' of the air; it is the result of decomposition. It is not, in these small quantities, hurtful, so far as we know. The ammonia is in no case free, but combined probably with hydrosulphuric, hydrochloric, and sulphuric acid in towns. In country places it is, at all events partly, united to carbonic acid.

The following table, showing the amount of ammonia present in rain collected at the different places named, is from Dr Smith's work, 'Air and Rain.'

COMPARATIVE. AMMONIA.

That of Valentia (Ireland) taken as 1 or 100.

Ireland, Valentia	·1
Scotland, sea-coast, country places, west	2·69
„ inland country places, west	2·96
„ sea-coast, country places, average	4·10
„ „ „ east	5·51
England, inland, country places, east	5·94
„ sea-coast, country places, west	10·55
German specimens	10·61
London, 1869	19·17
Scotland, towns (Glasgow not included)	21·22
St. Helen's	25·33
Runcorn	25·72
England, towns	28·67
Liverpool	29·89
Manchester, 1869	35·33
„ 1869 and 1870, average	35·94
„ 1870	36·54
Glasgow	50·55

According to Angus Smith, one kilogramme of air contains ammonia as follows:

Innellan (Firth of Clyde)	0·04 grms.
London	0·05 „
Glasgow	0·06 „
Manchester	0·10 „
Near a midden	0·26 „

The question of the effect of excess of carbonic anhydride in the *air* properly belongs to *ventilation*, and will be treated under that head. The function and destination of atmospheric ammonia will be referred to at length under the heading *Plants*.

Aqueous Vapour. "The moisture contained in the air is liable to much more extensive changes than even the carbonic acid. Amongst the circumstances which affect the atmospheric moisture, distance from masses of water, and the configuration of the land seem the most important. A given volume of air cannot take up more than a certain quantity of aqueous vapour at a given temperature, and then the air is said to be saturated with moisture. The weight in grains of water capable of being taken up by one cubic metre of air, at different temperatures, is given in the following table:

Temperature C°.	Weight of Water Grammes.
10°	2·284
0°	4·871
5°	6·795
10°	9·362
15°	12·746
20°	17·157
25°	22·843
30°	30·095
35°	39·252
40°	50·700
100°	588·73

Roscoe and Schorlemmer, loc. cit., vol. i. See under METEOROLOGY, HYGROMETER, DEW, RAIN.

Ozone. The experiments of Andrews have proved conclusively that an oxidising substance occurs in the atmosphere which agrees in all its properties with ozone. The quantity is, however, so exceedingly small that its determination is a matter of very great difficulty. The method of exposing iodised starch papers and comparing the tint obtained with certain standard tints is very rough and unreliable.

Ozone being active oxygen is probably an important agent in the destruction of organic matter in the air. The discovery of Gorup-Besanez that ozone is always formed when water evaporates points to its probable source, and may account for its presence in sea air and to a less extent in the air of country places. In towns the ozone is at once reduced to inactive oxygen by the organic matter, and especially the sulphurous anhydride present in the air, and derived from the combustion of coal. See OZONE.

Organic Matter. Volatile organic products of putrefaction are always present in the air, and others derived from respiration. The total organic matter is estimated as ammonia (see AIR, ANALYSIS OF). The nature of the organic matter in the air is exceedingly variable. That derived from respiration is known to be very poisonous, even in minute quantity; laying aside this and various emanations from soil and plants of whose nature and constitution we are ignorant, we may conveniently consider the organic matter in the air under two heads—*inanimate*, *i.e.* dust of all kinds, epithelium, dead vegetable cells, pollen grains, fragments of vegetable fibre, hair and wool, which will obviously vary enormously in quantity and quality with local conditions; and *animate particles*, micro-organisms, germs, spores, bacteria, and the like, which of recent years have

acquired very great importance as the possible source of disease.

Organisms in the Air. The results of investigations as to their relative numbers and their nature will only be dealt with here. For information as to their action in carrying infection and causing disease, &c., the reader is referred to the article BACTERIA.

The following is a *résumé* of a paper by Dr Percy Frankland, read before the Society of Arts, March 23rd, 1887. 'Journal Soc. Arts,' vol. xxxv, p. 485.

The first micro-organism to receive attention was *yeast,* and though the practical uses of it and the fact of its distribution in the air have been long known, the systematic investigation of aërial microbia begins with the classic researches of Pasteur, originally undertaken to meet the arguments of the supporters of the doctrine of spontaneous generation nearly thirty years ago.

Pasteur's methods and apparatus were very simple, and consisted of flasks holding about 250 c.c., whose necks were drawn out to an exceedingly fine point. The flask was partly filled with meat broth, frequently boiled to secure the death of any living material which might be present in the fluid, and whilst still boiling sealed in the blow-pipe. Armed with a quantity of these flasks, Pasteur explored the air of various places, by breaking the neck of a flask, allowing the air to enter, and then resealing it in the flame. The flasks were then taken to his laboratory, kept at a suitable temperature for some time, and the growth of organisms observed by the turbidity produced in the broth. The observations were made as follows:

1. 20 flasks opened in the open country of Arbois.
2. 20 flasks opened in the lower heights of the Jura Mountains.
3. 20 flasks opened at the Montanvert, close to the Mer de Glace, at a height of upwards of 6000 ft.

The flasks were deposited with the Academy of Sciences in November, 1860, and on examination some time afterwards,

Out of series 1, 8 flasks developed organisms.
„ 2, 5 „ „
„ 3, only 1 „ „

The presence of living organisms in the air was thus proved beyond all doubt.

Professor Burdon-Sanderson, Sir Joseph Lister, and Dr Tyndall, made similar researches in England with a like result. Dr Tyndall experimented more especially on the relation between the optical properties of air and their relation to the presence of living organisms, and showed that a beam of light is made visible by reflection from floating particles, and that air in which a beam of light remained invisible was incapable of infecting sterilised broth.

Quantitative Experiments. Miguel and Freundreich endeavoured to determine the number of organisms present in a given volume of air, by filtering a known quantity of air through sterilised cotton wool and counting the organisms. By a special process, which need not be here described, Hesse found that if the air were slowly drawn through a wide tube the organisms were deposited within a very short distance, confirming results obtained by Tyndall on the deposition of particles in still air.

Dr Percy Frankland using Hesse's method, has obtained the following results:

Roof of Science Schools, South Kensington:

1886—January	4	Average numbe of Colonies of Organisms obtained from 10 Litres of Air.
March	26	
May	31	
June	54	
July	63	
August	105	
September	43	
October	35	
November	13	
December	20	

Place of Experiment.	Organisms in 10 Litres of Air.
Primrose Hill, May 19th, 1886:	
Top	9
Bottom	24
Norwich Cathedral spire, April 26th, 1886:	
Top, 300 ft.	7
Tower, 180 ft.	9
Bottom (ground)	18
St. Paul's Cathedral, May 26th, 1886:	
Golden Gallery	13
Stone Gallery	34
Churchyard.	70
Reigate Hill, Feb. 7th, 1886	2
„ May 23rd, 1886	13
Heath near Norwich, April 23rd, 1886	7
„ „ April 27th, 1886	5
Garden at Reigate, May 23rd, 1886	25
Garden near Norwich, April 28th, 1886	31
Kensington Gardens, April 1st, 1886	13
Hyde Park, May 18th, 1886	43
„ June 7th, 1886	18
Roof of Science Schools, June 7th, 1886	62
Exhibition Road, June 7th, 1886	94
„ „ June 8th, 1886	554
„ „ „	309
„ „ June 10th, 1886	18

Organisms in Sea Air.—Dr Fischer, of the German Navy, using the same methods as Dr Frankland, found as follows:

(1)	14 expts.	average 113	litres each,	no organisms.
(2)	5 „	„ 80	„	1 „
(3)	2 „	„ 110	„	2 „
(4)	3 „	„ 146	„	3 „
(5)	6 „	„ 62	„	4–13 „

If classified according to distance from land the results give:

At a maximum distance of 90 nautical miles, 1 organism to 26 litres.

At a maximum distance of 120 nautical miles, 1 organism to 93 litres.

At greater distances no organisms were found, and the experiments afford proof of the carriage of germs by the wind.

The following figures are instructive as showing the effect of crowds of people.

		Organisms in Litres
Nat. History Museum, S. Kensington:		
May 21st, 1886, a.m.		50
„ „ p.m.		70
June 14th, 1886,	Whit Monday	280
„	„	267

Organisms falling on 1 square foot in 1 minute:

Chem. Laboratory, S. Kensington (4 expts.) .	15
S. Kensington Museum	54
Nat. History Museum (2 expts.) . . .	196
„ Whit Monday .	1662
Brompton Hospital	54

Nature of the Aerial Micro-organisms. The different kinds of bacilli and micrococci occurring in the air are less generally known than the moulds, which give more obvious proof of their presence.

Micrococcus candicans, Sarcina lutea, Sarcina aurantiaca, M. rosaceus, M. carnicolor, Bacillus aureus, B. fluorescens, B. chlorinus, B. subtilis, and *Saccharomyces,* besides others, are generally to be found.

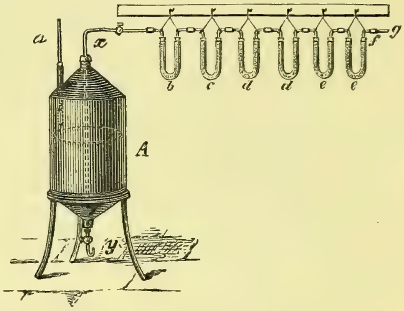
Of pathogenic forms it may be stated that practically none have been demonstrated in the air, but as their proportion to the non-pathogenic or saprophytic forms is infinitesimally small this is not surprising.

The organisms found in the air are those capable of exciting the fermentation of sugar and other bodies forming lactic and butyric acids, converting urea into carbonate of ammonia, ammonia into nitric and nitrous acids. Recent researches go to show that these results may each be brought about by totally different forms.

With these facts before us, and the knowledge we have of the results of the action of certain of these organisms, the importance of purifying the air and preventing its contact with food stuffs and the like is obvious; and the objects of antiseptic surgery require no explanation, if it be remembered that these organisms only travel readily in the dry state, the value of "laying the dust" with water and removing it will be readily understood. Some account of the various antiseptic and disinfectant substances will be found under the headings ANTISEPTICS and DISINFECTANTS, and under BACTERIA a brief statement of the scientific methods of sterilisation and disinfection as adopted in the laboratory and their practical application to everyday purposes.

Air, Analysis of. The discovery of oxygen by *Priestly* in 1774, and of nitrogen by *Rutherford* in 1772, directed the attention of chemists to the study of the composition of the atmosphere. The earlier methods of analysing air, although of the utmost historical value, need not be given here; an interesting account of them is to be found in Roscoe and Schorlemmer's chemistry, vol. i. In the actual analysis of atmospheric air (omitting for the present all reference to the organisms and solid particles which it contains), we have usually to deal only with the determination of oxygen, nitrogen, carbonic acid, and aqueous vapour, although in certain cases the relatively small amounts of ammonia, ozone, and other gases, also present, require to be estimated. Only such methods will be given here as are of use from a technical or hygienic point of view. They are taken from Fresenius's 'Quantitative Analysis.'

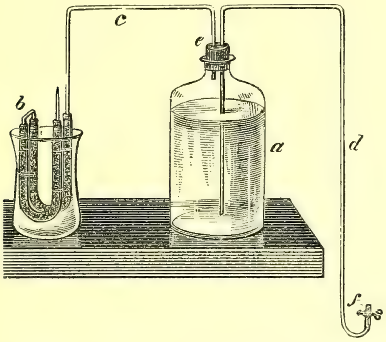
Determination of Aqueous Vapour and Carbonic Acid together. Brunner's method. In this method a given volume of air is aspirated through a series of tubes which absorb the aqueous vapour and carbonic acid respectively (see accompanying *diagram*). *A* is an aspirator (see ASPIRATOR) made of galvanised iron or sheet zinc, and of 50 to 200 litres (11 to 44 galls.) capacity. *a* is a thermometer, *x* a tube (reaching to the bottom of the aspirator), and *y* an outlet tube for the water, slightly bent up in order to prevent access of air. The U-shaped tubes *e e* and *c b* are filled with



pumice-stone moistened with strong sulphuric acid, while *d d* contain moist slaked lime (which is to be preferred to potash, as the latter absorbs not only carbonic acid, but also small quantities of oxygen). The connections between them must be absolutely tight, and—since caoutchouc is somewhat pervious to moist air—the connecting glass tubes should be thrust up close to one another inside the rubber tubing. Before the operation, tubes *e e* are weighed together and also tubes *d d c*; *b* is not weighed, as it merely serves to prevent any aqueous vapour entering the others from the aspirator. The object of tube *c* is to absorb any moisture carried over from the moistened hydrate of lime by the dry air. The aspirator having been filled with water, stop-cock *y* is opened and a given volume of air is allowed to pass *slowly* through the tubes, the rate being regulated by the flow of water from *y*. Not less than 25 litres of air should be taken, since the amount of carbonic acid in air is relatively very small, being on the average one eighth that of the aqueous vapour. When the operation is concluded, the tubes are weighed again, the increase in weight of *e e* giving the aqueous vapour and that of *d d c* the carbonic acid. In cases of very accurate determinations certain corrections have to be taken into account, *e.g.* the temperature and pressure before and after aspiration, &c.

Determination of Carbonic Acid alone. Pettenkofer's method. In this the carbonic acid in a given volume of air is absorbed by excess of baryta water of known strength, which has been titrated against a standard solution of oxalic acid. (See ACIDIMETRY and ALKALIMETRY.) It is useful to have two solutions of the baryta, $Ba(OH)_2$, a weaker one (1 c.c. = 0·001 grm. CO_2) for the absorption of smaller quantities of carbonic acid, and a stronger one (1 c.c. = 0·003 grm. CO_2) for the absorption of larger quantities. These must obviously be free from every trace of caustic potash or soda. The latter are tested for by titrating (1) a given volume of the *perfectly* clear solution with oxalic acid, and (2) another portion to which a little pure barium carbonate in a fine cream has been previously added. Should the

second require more acid for neutralisation than the first, then caustic alkali is present, in which case some barium chloride must be added to the baryta water, to make it available for use. The latter is best kept in such a bottle as is shown in the accompanying figure. Tubes *e* and *d* fit tightly into the caoutchouc stopper which closes *a*, *c* is connected with two U-shaped tubes *b* containing pumice-stone moistened with potash, while *d* is a siphon which is filled once for all by suction, a glass tube being attached to *f*. When a pipette or burette requires to be filled, its nozzle is inserted at *f*, and the clip compressed, when the liquid



immediately rises in it. The air which enters the bottle to replace the liquid run out is, of course, thoroughly deprived of its carbonic acid by the tubes *b*.

The baryta water is standardised from a solution of oxalic acid containing 2·8636 grms. of the pure crystallised acid ($H_2C_2O_4 + 2H_2O$) per litre; 1 c.c. of this solution $=0{\cdot}001$ grm. CO_2. The acid is run from a burette into 30 c.c. or so of the baryta water, accurately measured from another burette and contained in a small flask, the neutral point being determined either by delicate turmeric paper, or by any other suitable indicator. See ALKALIMETRY.

The actual analysis is performed by filling a bottle of known capacity, and provided with a good stopper, with the air to be analysed by means of a pair of bellows, then distributing over its sides 45 c.c. of the baryta water, and allowing it to stand closed for half an hour. The turbid liquid is then poured into a narrow cylinder, the latter well stoppered, and the precipitate of barium carbonate allowed to subside. After this, 30 c.c. of the clear liquid are taken out by a pipette and neutralised by the standard oxalic acid. The amount of the latter required, multiplied by $\frac{45}{30}$, *i.e.* by 1·5, is then deducted from the amount required by 45 c.c. of the fresh baryta water, the difference representing the quantity of carbonic acid in the air taken.

Various modifications of *Pettenkofer's* process have been worked out in recent years; one of which, specially adapted for the determination of the carbonic acid in expired air, is given under RESPIRATION.

Determination of Oxygen and Nitrogen. For the exact determination of oxygen in a mixture of gases, the reader is referred to Bunsen's 'Gasometric Methods,' German or English edition, and to other treatises on gas analysis. Liebig's method, which will now be given here, allows of its determination in air to within 0·1% to 0·2%, and requires only very simple apparatus. It is based upon the fact that an alkaline solution of pyrogallic acid readily absorbs oxygen.

A strong measuring tube of about 30 c.c. capacity, and graduated into fifths or tenths of a cubic centimetre, is filled two-thirds with the air for analysis, the remaining third containing mercury; it is then inverted over mercury contained in a tall cylinder widened at the top (see fig. 1). After the whole has acquired the temperature of the room, the volume of the air is read off, temperature and pressure being carefully noted. A quantity of potash solution of 1·4 sp. gr. (1 part KOH to 2 parts water), amounting in volume to $\frac{1}{40}$th or $\frac{1}{50}$th of the air, is then introduced into the measuring tube by means of a pipette with the point bent upwards (fig. 2), and

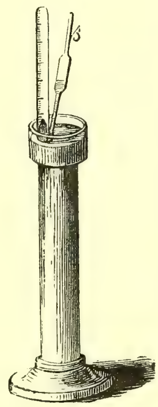


FIG. 1.

FIG. 2.

spread over the entire inner surface of the tube by shaking the latter. When no further diminution in volume occurs, another reading is taken, the decrease representing the carbonic acid present. (Should the latter amount to several parts per cent., its quantity may be determined in this way with tolerable accuracy, if the original air—previous to the first reading—be dried by introducing into it for some time a small ball of fused calcium chloride, free from lime, on the end of a platinum wire.) A solution of pyrogallic acid (1 grm. in 5 or 6 c.c. water) is next introduced by means of another pipette similar to the above, the volume of the solution taken being about half that of the potash, and the liquid again spread over the surface of the tube; when no further diminution in volume is observed, the residual nitrogen is read off, the decrease representing the oxygen.

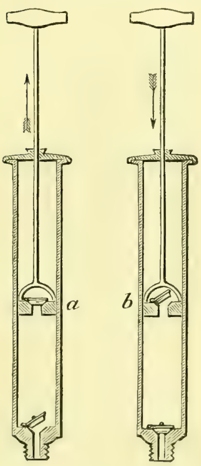
In making these readings the necessary corrections for temperature and barometric pressure must of course be made. See GASES and BAROMETER.

Determination of Ammonia and Organic Matter in Air. Owing to the small quantities present this is a difficult operation. It can best be performed by aspirating slowly a large volume

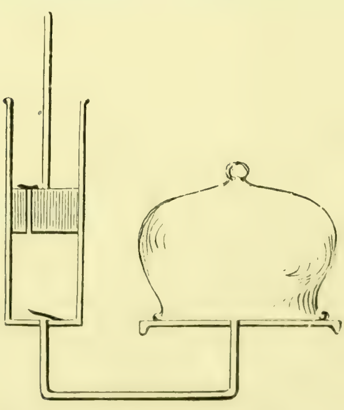
of air through water carefully distilled and freed from ammonia. The ammonia in the water is then estimated in the usual way. See WATER ANALYSIS. The organic particles which might yield ammonia under the treatment for analysis, may be kept out by the use of a plug of baked cotton wool, and the amount thus determined by difference.

AIR-GAS. Air deprived of its carbolic acid and moisture, and then impregnated with the vapours of very volatile fluid hydrocarbons, such as benzine and benzoline, can be used as an illuminating agent. It is requisite, however, to use burners with wide openings, and to apply a low pressure, because if the current be too rapid the flame becomes too much cooled, and is readily extinguished. Apparatus for preparing air-gas have been devised and constructed by Marcus, Mille, Methei, and others.

AIR-PUMP. An instrument invented by Otto Guericke about 1650, and designed for the removal of air from closed vessels.



The simplest form of air-pump is the exhausting syringe, which consists of a cylinder fitted with a stopcock, and having a valve at the bottom opening inwards; another valve opening outwards is attached to a piston working inside the cylinder. The pump is screwed on to any vessel which it is desired to exhaust, and the piston alternately elevated and depressed until the air-pressure within the vessel has been so far reduced that the instrument ceases (on account of the failure of the valves to move) to carry the exhaustion farther (see figs. *a* and *b*). The accompanying figures show the relative positions of the valve during (*a*) the elevation, and (*b*) the

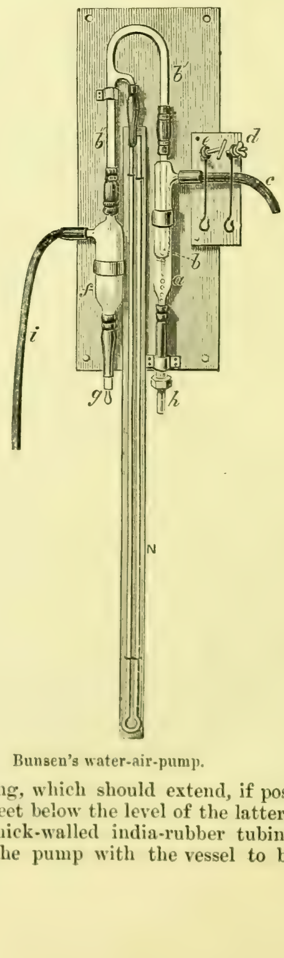


depression of the piston. Instead of valves we may have stopcocks, which require, of course, to be alternately opened and closed as the piston ascends and descends.

In the usual and more convenient form of air-pump, a brass tube from the bottom of the syringe terminates in a plate of accurately ground glass or polished brass, upon which the bell-jar to be exhausted (the bottom of which is likewise accurately ground) is placed (see figure). To enable the operator to judge of the progress of the exhaustion the pump is usually provided with a mercurial gauge.

The foregoing figures show a pump with a single barrel; but double-barrelled ones, in which one piston ascends as the other descends, or single-barrelled ones with double action, are more frequently used. A description of these will be found in Deschanel's 'Natural Philosophy.'

Bunsen's Water Air-pump (see figure).—This consists of a wide glass tube (*a*), into which another narrower one (*b*, *b'*, *b''*) is fused, or, in default of that, bound air-tight with thick india-rubber tubing; *c* is an india-rubber tube connecting *a* with the water supply; *d* a clamp to stop the flow of water through *c*, and *e* another clamp to regulate that flow; *f* is a reservoir to prevent any water which may come over accidentally from getting into *i*; *g* a plug to let out any water from *f*, and *h* a screw for connecting *a* air-tight to a

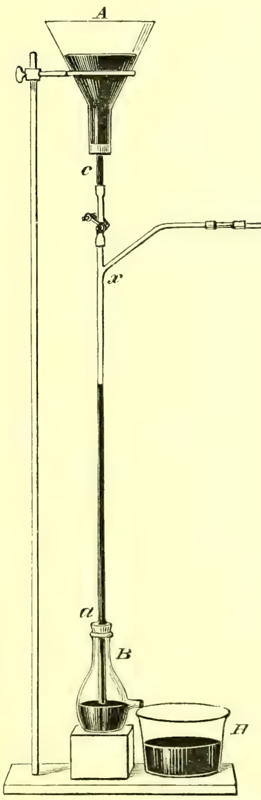


Bunsen's water-air-pump.

piece of piping, which should extend, if possible, thirty-four feet below the level of the latter; *i* is a piece of thick-walled india-rubber tubing for connecting the pump with the vessel to be ex-

hausted, and N a mercury gauge to show the degree of that exhaustion. The water rushes in at *c* and down *h*, carrying bubbles of air with it. This flow of water through the tube surrounding the nozzle causes the pressure beneath the latter to be so far below atmospheric pressure that a fairly complete vacuum can be produced within the vessel with which the nozzle communicates. This pump is very useful for facilitating the filtration of liquids, which would run but slowly if the pressure in the receiving vessel were not reduced.

Sprengel's Air-pump (see Deschanel's 'Natural Philosophy'). In this pump the vacuum is produced by communication of the receiver with a Torricellian vacuum. The simplest form of it is shown in the subjoined figure. *c d* is a glass tube longer than a barometer tube, open at both ends, and tightly fastened by thick india-rubber tubing, with screw-clip attached, to the funnel *A*, which



Sprengel's air-pump.

is itself supported on a ring. The lower end of *c d* is fixed by a cork into a vessel *B*, the latter being provided with an outlet tube at a level slightly above that of the foot of *c d*. *x* is a branch tube, to which any vessel *R* to be exhausted is joined. *A* is filled with mercury, which is allowed to run down the tube at a rate regulated by the clip. The exhaustion immediately begins, and the whole length of the tube from *x* to *d* is seen to be filled with cylinders of mercury separated by cylinders of air, all moving downwards. Air and mercury escape through the spout of *B*, the mercury finally collecting in *H*, from which it is poured back from time to time into *A*, to be repassed through the tube till the exhaustion is completed. When this stage is reached the lower part of *c d* is filled with a continuous column of mercury about thirty inches high, and each drop, as it falls from *A* on to this column, gives out the peculiar clicking sound common to all liquids shaken in a vacuum. The operation may be considered completed when the column of mercury does not enclose any air, and when a drop of mercury falls upon the top of this column without enclosing the slightest air-bubble. The height of this column now corresponds, of course, exactly with that of the column of mercury in a barometer. The average exhaustion of air attainable with such a pump is to about one millionth of the original density, *i. e.* 0·0076 mm. (0·0003 in.)

Some other forms of water-pump suitable for use in laboratories where there is a good pressure of water, are described in the article on FILTRATION.

AIRY'S (Dr.) NATURE'S MEDICAL TREATMENT is the title of a pamphlet which recommends four secret remedies against 166 diseases!!

a. The Pain Expeller, a mixture of about 35 parts of tincture of capsicum, 20 parts of diluted spirit, and 20 parts of spirit of ammonia.

b. Sarsaparillian, a fluid extract of sarsaparilla and China root, containing 1% of iodide of potassium.

c. Pills composed of powdered iron, jalap resin, jalap powder, and marsh-mallow powder, made into a mass with some bitter extract. Each pill weighs 0·1 gramme.

d. Calming Pastilles are thick, hard tablets, composed of sugar, with oil of anise, and coloured with liquorice juice. (*Hager.*)

AJOWAN. *Syn.* BISHOP'S WEED (*Ptychotis ajowan; Carum copticum*). An annual herb cultivated in many parts of Egypt, Persia, Afghanistan, and adjacent countries, and abundantly in Bengal. The fruits are stimulant and carminative, and contain an oil from which thymol is obtained. See THYMOL.

AL-. [Ar.] An inseparable article equivalent to the English *the*. It is found in many chemical and other words derived from the Arabic, as alchemy, alcohol, alembic, almanac, &c.

AL'ABASTER. *Syn.* ALBÂTRE, Fr.; ALABA'STER, ALABASTRI'TES, ALABA'STRUM, L. (Said to be derived from the Arabic *al bastraton*, the whitish stone.)

Properly the name should be restricted to the fine massive variety of gypsum, but a crystalline carbonate of lime also passes under the name. (See *below*.)

It is found in large and pure masses in various parts of Tuscany, and Florence is the centre of the alabaster trade. It was at one time quarried at Lagny, near Paris, and in England considerable deposits exist in Derbyshire and Staffordshire. A yellow variety found near Siena is termed 'Alabastro Agatato.' Alabaster having a fibrous structure is termed 'Satin Spar.'

Oriental Alabaster is really stalagmite deposited on the floors of limestone caves. When cut and polished it presents markings resembling

those of agate. The principal quarries are at Oran in Algeria. There are ancient quarries near Thebes, but the principal sources at the present day are Oran, the Pyrenees, Chili, and California.

GYP'SEOUS or COMMON ALABASTER; GYPSUM. A natural hydrated sulphate of calcium, containing a little carbonate of calcium. That from the quarries of the Paris basin contains about 12% of the latter substance. When calcined or roasted, and powdered, it forms the substance known under the name of PLASTER OF PARIS. The more compact, fine-grained specimens of this variety are, like the preceding one, sculptured into almost numberless articles of ornament and utility, such as vases, clock-stands, statuettes, &c. The inferior kinds only are manufactured into the 'plaster of Paris' of the shops. The best specimens are obtained from the lower beds of the gypsum quarries, and are white, and granular, not unlike Carrara marble. It takes a high polish; but from its softness and liability to become discoloured, articles formed of it require more careful treatment than even those of 'calcareous alabaster.'

Alabaster is wrought, turned, and fashioned, in a nearly similar manner to the softer varieties of marble. The tools resemble those employed for the like operations in ivory and brass. Machinery is now often applied to this purpose.

Alabaster is polished, first with pumice-stone, and then with a paste or pap made of whiting, soap, and milk or water; and lastly, with dry flannel. A better method, however, is to rub it first with dried shave-grass (equisetum), and afterwards with finely powdered and sifted slaked lime formed into a paste with water. The surface is then 'finished off' by friction with finely powdered talc or French chalk, until a satiny lustre is produced, or with putty powder, in a similar way to marble.

Alabaster is engraved with tools resembling those employed for other soft minerals. It is etched by covering every part of the surface, except that to be acted on, with a solution of white wax in oil of turpentine (1 to 4), thickened with a little finely powdered white lead, and subsequent immersion in water acidulated with acetic acid or hydrochloric acid, for the calcareous variety; and in spring water, for 20 to 50 hours (according to the effect desired), for the gypseous variety. The varnish is washed off with oil of turpentine, and the etched parts carefully brushed over with finely powdered gypsum.

Alabaster is joined and repaired by means of white of egg, or rice glue, thickened with finely powdered quicklime; or by a paste of newly baked and finely powdered gypsum, mixed up with the least possible quantity of water.

Calcareous alabaster is usually cleaned with a brush and warm soap-and-water, or with tepid water to which a few grains of carbonate of soda or of ammonia have been added; followed in either case by rinsing in clean water. If much discoloured, thoroughly cover the article with a paste of freshly-slaked lime and water, and let it remain twenty-four hours; then wash off the paste with soap and water, rubbing the stains hard.

Delicate objects in gypseous alabaster can only be safely cleaned with benzol, or with pure oil of turpentine. If necessary, the surface must be repolished. Grease spots may be removed from either variety with a little benzol or oil of turpentine.

Alabaster is occasionally stained or coloured, and, for the calcareous variety, in a similar way to marble, except that heat is not employed; and for the gypseous variety, in the manner noticed under PLASTER OF PARIS. The gypseous variety is also bronzed and hardened in a similar way to that adopted for casts in the latter substance.

Obs. Gypseous alabaster is dissolved by water; and the beauty of both varieties is almost irrecoverably destroyed by grease, coloured oils, varnishes, smoke, &c. It is, therefore, unfitted for garden ornaments, or other objects exposed to the rain or weather, unless it be painted or bronzed; and is even then very perishable. Contact with acids, alkalies, and ammoniacal and sulphurous fumes, also injure, and, if prolonged, destroy it. Even an uncorked phial of smelling-salts placed on a mantel-piece beside an alabaster vase will soon destroy its beauty. Thus, all delicate objects in alabaster should be protected by a glass shade.

Alabaster, Orient'al (Factitious). Figures, basso relievos, &c., of considerable hardness and beauty, may be formed by immersing suitable moulds in the water of calcareous springs, as at San Filippo, in Tuscany, and other places.

Proc., &c. Moulds of sulphur are placed either vertically or obliquely in an open tub or cistern, having a freely perforated bottom. Surmounting the whole are two or more pieces of wood in the form of a cross or star. The sulphurous calcareous water, falling on this cross, is scattered into spray or streamlets, and losing the gaseous portion which holds the lime in solution, deposits it in the form of oriental alabaster on the surface of the moulds. In from 1 to 4 months, according to the nature of the article, a sufficiently thick deposit is obtained. The object is then removed from the mould, and trimmed and polished. It is found that the more vertical the position of the mould, the finer is the grain of the resulting deposit. The water of the Spring of San Filippo may be exactly and easily imitated by the chemist; and the whole process offers a new and valuable ornamental art for the amusement and profit of the ingenious and enterprising.

Alabaster, Shand's Chinese. Carbonate of lime. (*Chandler.*)

Alabaster Tablets, John Swine's Chinese. Carbonate of lime. (*Chandler.*)

ALAMODE' (ăl-ăh-mōde). [Fr., *à la mode.*] According to the prevailing mode or fashion. In *cookery*, applied to several dishes, but more particularly to one of beef (alamode beef), commonly shortened by the lower class of Londoners into 'alamode.' See BEEF, STEWING, &c.

ALAN'TINE. [Eng., Fr., Ger.] *Syn.* ALANTI'NA, L. A substance identical with inulin, found in the roots of garden angelica (*Angelica archangelica*, Linn.).

ALBA'TA. [L., Eng.] A name given to several alloys resembling silver. See ALLOYS, GERMAN SILVER, &c.

ALBATROSS. A genus of long winged aquatic birds belonging to the order Natatores. There are only three species, of which the best known

is the Common or Wandering Albatross (*Diomedea exulans*) found in all parts of the Southern Ocean and the seas that wash the coast of Asia to the South of Behring Strait. It is the largest and strongest of all sea birds. The body is about 4 feet long, and the weight 15 to 25 lbs.; the average expanse of the wings is 10 to 12 feet, specimens measuring as much as 17 feet have been found. Its powers of flight are very great, and it can keep on the wing for days without even resting on the water. Its food is small fish; the flesh is hard and unsavoury. The long wing bones are valuable for the manufacture of pipe stems. The bird lays but one egg, white with a few spots, and about 4 inches long, It breeds in solitary, uninhabited places such as the Crozet Islands and Tristan da Cunha. The nest is a mere hollow in the earth. In colour the bird is a dirty white with slightly darker wings, and a few dark stripes on the back.

ALBERT-TYPE. So called from the name of its inventor, Albert, of Munich. A photo-mechanical process, for the reproduction of photographs. See PHOTOGRAPHY.

ALBI'NO, ALBINISM, or **LEUCOPATHIA.** A condition of the organism characterised by an absence of pigment in the deeper layers of the epidermis, and in certain other parts of the body, notably in the choroid coat of the eye and in the iris; the hair is either quite white or flaxen. Albinism may be either complete or partial, in the latter case a curious piebald appearance is produced. The defect of colouring matter in the eye renders the retina exceedingly intolerant of light, so that an albino always has weak eyes; the pupils are more or less contracted, the eyelids droop, and the head is generally bent, in order to protect the eyes as much as possible from the light. Albinos are usually short-sighted. Albinism can hardly be called a disease, and is by no means necessarily associated with weakness of intellect, as is sometimes supposed to be the case. It is hereditary to about the same extent as blindness and deafness.

Darwin ('Animals and Plants under Domestication,' cap. xii) mentions the case of two brothers who married two sisters, their first cousins, none of the four nor any relation being an albino; seven children the result of this double marriage were *all* perfect albinos. In some genera of animals albinism is a common and almost natural occurrence. White rats and mice, white hares and rabbits, and even white blackbirds are cases in point. The rarity of a white elephant is, however, such that it has passed into a proverb, and the animals are regarded with veneration by some Asiatic nations.

Treatment. Not being a definite disease but rather a defect, the only treatment possible is to attend to the general health, and assist the eyes. Spectacles in which perforated plates of aluminium, or other light metal, replace the glass, have been found useful, in enabling the wearer to see with greater comfort.

ALBO-CARBON BURNER. A patented gas-burner, in which the illuminating power of the gas is increased by its being caused to pass through melted naphthalene, contained in a metal chamber. The heat necessary to melt the hydrocarbon is obtained from the light itself, by means of a plate of metal which projects from the tube conveying the gas to the chamber; this becoming hot, the heat is conducted by the gas tube to the chamber, which quickly becomes sufficiently hot to melt the naphthalene. The patentees claim greatly increased illuminating power at a less cost than if obtained by the requisite consumption of gas in the ordinary way.

ALBOLITH. A cement powder prepared by W. Riemann, Breslau. Made with calcined magnesia (obtained from magnesite) and chloride of magnesium. It is recommended for painting walls, stairs, and wooden articles. (*Hager.*)

ALBU'MEN. [Eng., L.] *Syn.* ALBUMIN; ALBUMINE, Fr.; EIWEISS, EIWEISSTOFF, Ger. Literally, the white of egg; a peculiar nitrogenous substance which enters largely into the composition of animal bodies. It abounds in the blood, muscles, bones, coagulable lymph, vitreous and crystalline humour of the eye, fluid of dropsy, &c.

Prep. The white of egg and the serum of blood, when strained through muslin, furnish albumen, in solution, in a sufficiently pure state for all the ordinary purposes of the arts.

To prepare a solution of albumen (white of egg) it is necessary to separate the membranes in which it is enclosed. This is best accomplished by beating the whites of eggs with a fork or egg whisk, then placing the albumen in a flask with four or five times the volume of water (the flask to be only half filled), and shaking violently for some time; the membranes then float on the surface, and the solution can be easily filtered.

Uses, &c. Independently of its value as an alimentary substance, albumen is largely employed in photography as a glaze or varnish; for fixing colours in calico printing; as a cement, &c., and more particularly as a clarifier for wines, syrups, vegetable solutions, and other liquids. Its efficacy for the latter purpose depends on its entangling the impurities in its meshes during coagulation, and either rising to the surface with them as a 'scum,' or sinking with them as a precipitate. In France it is prepared on an extensive scale, at the abattoirs; the source of supply being, of course, the serum of the blood of the slaughtered animals, which is spread in thin layers to dry. When the liquid operated on does not spontaneously coagulate albumen it is necessary to apply heat to it. In cases of poisoning by the mineral acids, corrosive sublimate, nitrate of silver, sulphate of copper, bichloride of tin, or sugar of lead, the white of egg (or indeed the yolk as well) is one of the best antidotes that can be administered.

Albumen is the type of a large class of bodies found in the animal kingdom, and known collectively as *albuminous* or *proteid* substances; they are all derived originally from plants and converted to the purposes of the animal organism, and are composed of C. H. O. N. and S.

According to Hoppe Seyler their general percentage composition is—

	O.	H.	N.	C.	S.
From	20·9 .	6·9 .	15·2 .	51·5 .	0·3
To	23·5 to	7·3 to	17·0 to	54·5 to	2·0

All the attempts which have been made to give these bodies a rational formula have been unsuccessful, and their real structure and composition is but little understood.

They exist in all animal fluids and tissues except the bile and urine. They form the chief part of muscles, nerves, glands.

In the alimentary canal they are changed into peptone. See PEPTONE.

Characters. They are all amorphous *colloids*, and do not crystallise nor dialyse. Some are soluble, others insoluble in water; all are insoluble in alcohol, and all their solutions rotate the ray of polarised light to the *left*. They are *coagulated* by heat, mineral acids, and the prolonged action of alcohol.

Reactions. 1. With strong HNO_3 they coagulate and turn yellow on boiling. Addition of ammonia changes the yellow to deep orange (*xanthoproteic reaction*).

2. Millon's reagent (nitrate of mercury with nitrous acid), gives a white precipitate, which becomes pink or red on boiling.

3. A reagent, prepared by adding one drop of a very dilute solution of cupric sulphate to about 5 c.c. of strong caustic soda solution, gives with proteids a purple colouration.

4. Acetic acid and potassium ferrocyanide precipitate proteids.

5. Boiled with acetic acid and an equal volume of sodic sulphate (concentrated solution), they are precipitated. This is a useful method of getting rid of proteids previous to testing for other bodies.

6. Tannic acid coagulates albuminous solutions.

Native Albumins. Serum and egg. Are soluble in water.

Globulins are proteids insoluble in water, but soluble in dilute solutions of neutral salts. The *Fibrinogen* of the blood and *Myosin* of dead muscle are the best examples.

Derived Albumins. Acid and alkali albumin may be prepared by treating white of egg with acetic or hydrochloric acid and caustic alkali respectively. The resulting products are no longer coagulable by heat, and are precipitated on neutralising the solutions. The *Casein* of milk is closely related to alkali albumin.

Other proteids are fibrin, peptones (digested proteids), and various vegetable proteids such as gluten, legumin, &c. See FIBRINOGEN, CASEIN, GLUTEN, LEGUMIN.

Albumen, Flake. *Syn.* ALBUMEN IN POWDER, SOLID A., SOLUBLE A., PLANTERS A. *Prep.* Expose strained white of egg or serum of bullock's blood, in a thin stratum, to a current of dry air, until it concretes into a solid transparent substance resembling horn. In this state it may be kept any length of time, or it may be further dried until brittle, and then reduced to coarse powder.

Use. It is extensively employed as a 'clarifier' in the sugar plantations of the West Indies, and elsewhere. It is prepared for use by soaking and stirring it with *cold* water until it is dissolved, when it is whisked to a froth in the usual way, and agitated with the liquid to be clarified.

Albumen, Solution of (B. P.). Take of white of one egg; distilled water, four fluid ounces. Mix by trituration in a mortar, and filter through clean tow, first moistened with distilled water. The method of shaking in a flask described above facilitates filtration very greatly. This solution must be recently prepared.

Albumen, Vegetable. This substance, long considered to be a distinct proximate principle peculiar to the vegetable kingdom, has been shown, by recent researches, to be identical with animal albumen. The term must now be regarded as quite indefinite, and as only expressing vegetable proteids. Chiefly globulins and albumoses. (See *below*.)

Albumen. In *botany*, the solid, fleshy, or horny substance found in many seeds, between the integuments and the embryo. It is the part that furnishes the flour of the 'cereals,' the flesh of the 'cocoa-nut,' and the great mass of the seeds of coffee and other vegetables. However poisonous the plants which produce it may be, this substance is never deleterious.

ALBUMENISED PAPER. A French paper, having a fine surface, and made by Rive; a German paper having a more uniform texture, and made by Saxe; also a paper by Towgood, are recommended for the preparation of albumenised paper. Positive paper may be albumenised as follows:—Add 15 gr. of finely pulverised common salt, or better, 8 gr. of chloride of ammonium, dissolved in the least possible quantity of water, to the white of every egg used, and whisk until the mixture is entirely converted into a white froth. Allow this froth to stand in a glazed earthenware pan for about 12 hours. At the end of this filter through two or three thicknesses of clean fine muslin and pour the clear portion of the liquid into a flat porcelain tray, which must be rather larger than the sheets of paper to be albumenised; mark the inferior side of the paper, slightly damp it, lift it by its ends, and float it carefully on the prepared albumen, keeping its inferior and dry side uppermost. Then raise the paper at each end, and if any air-bubbles are seen remove them with a card or brush, and replace the paper in the bath. Remove the paper from the bath and suspend it at the corners by clips. Albumenised paper should be kept dry by enclosing it in tin or zinc cases.

Paper is described as single, double, or treble albumenised according to the number of times it has been floated and dried. The process is one requiring much patience and practice to accomplish successfully, and it will be found best to purchase the paper if possible. See PHOTOGRAPHY.

ALBUMENOIDS. A term applied to albumen, fibrin, casein, and similar bodies.

ALBU'MENOUS. *Syn.* ALBUMINO'SUS, L.; ALBUMINÉ, ABUMINEUX, Fr.; EIWEISSTOFFHALTIG, Ger. Formed of, containing, or having the properties of albumen.

Albuminous Plants. In *botany*, all plants whose seeds contain albumen in a separate state; as in the cereals, palms, &c.

ALBUMINURIA. See URINE.

ALBUMOSE. An intermediate product in the digestion of proteids, between the proteid and peptone. Most commercial peptones consist

chiefly of albumose. Albumose may be separated from peptones by saturating the solution with ammonic sulphate; the precipitate produced is albumose; the peptone remains in solution. See DIGESTION.

ALBURN'UM. [L.] *Syn.* ALBURN*; SAP-WOOD. In *botany*, the white and softer parts of the wood of exogenous plants, lying between the inner bark and the heartwood. It consists of empty, or nearly empty, tubes or cells, which gradually acquire solidity by the deposition of resins, tannin, and other products of vegetation, and in time becomes wood. It is through the alburnum that the ascending sap chiefly flows.

ALCARAZ'ZA. [Sp.] A species of porous earthenware, or a vessel formed of it, made in Spain from a light, sandy marl, and but slightly fired. Their value as 'coolers' arises from the copious evaporation of the water, which gradually transudes. A similar ware and articles are made in France, under the name of HYGROCERA'MEN; and in England, under the names of POROUS WARE, WATER COOLERS, WINE COOLERS, BUTTER COOLERS, &c. As water coolers, though efficient, these vessels are very objectionable; being porous, their walls become choked with organic matter, and organisms and algæ of various kinds flourish in them; their structure renders them incapable of being cleaned except by heating to a high temperature. The object may be equally well attained by setting the material to be cooled under a large flower-pot placed in a dish of water; the constant evaporation cools the interior, and anything placed in it. The apparatus should be set in a current of air. See EVAPORATION.

The following are formulæ said to be used in our potteries:

Prep. 1. Take of sandy marl, 2 parts; brine, q. s.; make a dough, and then knead in of common salt, in fine powder, 1 part. Bake the pieces slowly, and lightly.

2. Good clay, 2 parts; fine siliceous sand, 3 parts; brine, q. s.; common salt, 1 to 2 parts; as before.

3. Powdered clay, 2 parts; powdered charcoal, 3 parts (by weight); water, q. s. to form a stiff dough. The kilning must be so arranged that the heat is applied gradually, and the vessels exposed to a current of hot air; and it must be continued until all the charcoal is burnt out, carefully avoiding overfiring.

AL'CHEMY (-kĭm-). *Syn.* AL'CHYMY (-kĭm-); HERMETIC ART*; ALCHEM'IA, ALCHYM'IA, L.; ALCHIMIE, Fr.; ALCHEMIE, Ger.; ALCHIMIA, It. The romantic forerunner of the modern science of chemistry. An imaginative art or science, having for its objects the discovery of a substance (PHILOSOPHER'S STONE) capable of transmuting the baser metals into gold—a panacea, or universal remedy (ELIXIR VITÆ), by which disease and death were to be avoided by its possessor—an alkahest, or universal solvent—a universal ferment; and other like absurdities. A mixed metal formerly used for utensils was also called by this name.

ALCOHOL. *Ethyl alcohol, ethyl hydrate, methyl carbinol.* C_2H_6O. B. P. 78·4° C. (173·1° F.); sp. gr. (1) ·79367 at 15° C., compared with water at 4° C. (*Mendelejeff*); (2) ·79350 at 60° F., compared with water at the same temperature (*Squibb*).

[Eng., L.; B. P.] *Syn.* ALKOHOL, Eng., L.; ALCOHOL, Fr.; ALKOHOL, HÖCHST RECTIFICIRTER WEINGEIST, Ger.; ALCOÖLE, It. A term commonly applied to the spirituous liquid obtained by distilling fermented saccharine liquids.

Etym., &c. The name is derived from the Arabic 'al kohol,' meaning a grinding, and originally applied to a preparation of powdered antimony used as a cosmetic; it afterwards came to be applied to spirit.

Hist., &c. Although the art of distillation was probably known at a comparatively early age, the preparation of pure rectified spirit is a discovery of modern times. It was not until the thirteenth century that Raymond Lully first showed how to concentrate spirit by means of carbonate of potash, after which date the pure concentrated product gradually rose into note as an article of trade and commerce in Europe. In the sixteenth century its distillation was in common practice in these countries (*Burns*). By means of chloride of calcium Dr Black obtained alcohol of 0·800 sp. gr. (about the year 1760), and Richter afterwards procured it of a sp. gr. so low as 0·796 at 60° F. (Crell's 'Annals,' 1796). It was Lavoisier who first demonstrated the composition of alcohol (about 1780).

Sources. Dilute alcohol may be procured, by the ordinary process of distillation, from all fermented liquors. When obtained from wine it forms brandy; when from the refuse juice of the sugar-cane, rum. These contain about half their volume of alcohol, their flavour being due to small amounts of essential oils produced in the particular fermentation, and carried over with the alcohol. These essential oils are removed by a second distillation.

Chemistry. The pure compound C_2H_6O may be regarded as water, HOH, in which an atom of hydrogen has been replaced by the radicle C_2H_5; thus: $(C_2H_5)OH$.

A large number of these hypothetical radicles or groups are known in chemistry, and hence it is possible to prepare artificially a series of compounds known by the generic name of alcohols, all of which possess a similarity of constitution and properties. The following are the names and formulæ of the lowest of the 'fatty' alcohols (see 'FATTY' COMPOUNDS).

Methyl alcohol . . .	CH_3. OH
Ethyl alcohol (ordinary alcohol)	C_2H_5. OH
Propyl alcohols . . .	C_3H_7. OH
Butyl alcohols	C_4H_9. OH
Amyl alcohols	C_5H_{11}. OH, &c.

Most of these occur in commercial products; thus methyl alcohol is the main constituent of wood spirit, and is therefore a constituent of methylated spirits of wine. Propyl alcohol occurs in the fusel oil, or residue after distillation in the preparation of brandy from wine; butyl alcohol in that from molasses or beetroot. Amyl alcohol forms the main constituent of the fusel oil from corn, potatoes, or must of grape.

Alcohol may be produced synthetically by dissolving olefiant gas, C_2H_4, in sulphuric acid, and

distilling the product with water, the reactions being as follows:

$$C_2H_4 + H_2SO_4 = \underbrace{(C_2H_5)HSO_4}_{\text{Ethyl-sulphuric acid.}}$$

$$(C_2H_5)HSO_4 + H_2O = (C_2H_5)HO + H_2SO_4$$

Since the olefiant gas can be obtained by the action of nascent hydrogen on acetylene, C_2H_2, and this in its turn can be prepared by the direct union of carbon and hydrogen, we see that it is possible to produce alcohol from its elements. This process is, however, only of theoretical interest.

On the large scale alcohol is always prepared by the distillation of saccharine liquids which have undergone fermentation. In these cases the alcohol is always formed by the breaking down of grape sugar or its equivalent—

$$\underbrace{C_6H_{12}O_6}_{\text{Grape sugar.}} = 2C_2H_6O + 2CO_2$$

(See FERMENTATION.)

Absolute Alcohol. Alcohol and water cannot be completely separated by simple distillation. Hence, to obtain pure or anhydrous or *absolute* alcohol, it is necessary to add to the liquid some substance which will combine with the water, when the pure alcohol can be distilled off in the ordinary way. The following substances have been used for this purpose:—anhydrous copper sulphate, carbonate of potash, chloride of calcium, and quicklime. Of these quicklime is undoubtedly the best. Chloride of calcium is a powerful desiccating agent, but it forms a compound with alcohol, and hence its employment leads to waste. Anhydrous carbonate of potash (ignited pearlashes) is useful in effecting a preliminary removal of water.

With quicklime: the lime, which should be freshly burnt, is roughly powdered and introduced into a flask, and the spirit added. The flask is now corked and set aside for two days, at the end of which time it is connected with a condenser, and the alcohol distilled off at as low a temperature as possible (over a water-bath). Too much quicklime should not be used, as it retains alcohol. Alcohol of 97% requires $\frac{5}{16}$ths of its weight of lime to dehydrate it; alcohol of 91% requires its own weight. If the alcohol contains more than 5% of water, however, it is best to use less lime and repeat the process.

Instead of leaving the alcohol and quicklime together for two days, the dehydration may be accelerated by fitting the flask with an upright condenser and heating the mixture to boiling for an hour. The alcohol may then be distilled off as before.

The following, taken from Muspratt's 'Dictionary of Applied Chemistry,' is the method which was used by Drinkwater in his investigation on absolute alcohol ('Phil. Mag.,' vol. xxii, 1848, p. 123), and will give some idea of the precautions to be taken. "Potassium carbonate was exposed to a red heat, to deprive it of water, and when sufficiently cool was pulverised and added to ordinary alcohol of sp. gr. ·850 till it ceased to dissolve any more; the menstruum was then allowed to digest twenty-four hours, being frequently agitated, and the alcohol carefully separated by decantation. As much fresh-burned quicklime as was considered sufficient, when powdered, to absorb the whole of the alcohol, was introduced into a retort and the alcohol added to it; after digesting forty-eight hours, it was slowly distilled over a water-bath at a temperature of about 180° F. (82° C.). The alcohol thus obtained was carefully redistilled, the retort again filled with fresh-burned and pulverised quicklime, and the same alcohol mixed with it; the mixture was then allowed to digest a whole week, at the ordinary temperature of the laboratory. After this lapse of time the alcohol was distilled off as before, and the distillate submitted to a second operation, which was conducted at first at the rate of about one drop in 10 seconds, the heat of the water-bath being 165° F. (74° C.). The distillation was continued thus till about one-twentieth of the whole had passed over, the object being to allow any minute quantity of water which the alcohol might still retain to evaporate or diffuse itself into the atmosphere of absolute alcohol above it; the process was then continued rapidly, the heat of the bath being raised to 180° F. (82° C.), till about one-twentieth more had passed over, when the receiver was changed, and the latter portions slowly eliminated. The sp. gr. of the alcohol was ·7944 at 60° F. (15·5° C.). This alcohol was again digested at a temperature of about 150° F. (65·5° C.) for fourteen days with quicklime previously heated to redness, as in the former experiment; it was then slowly distilled, out of contact with the external atmosphere, at a temperature of 175° F. (79·3° C.), and the first tenth part put aside as possibly containing a minute quantity of water; the remainder was then distilled off at 178°—180° F. (80·8°—82° C.). This alcohol was quickly transferred to a dry retort and redistilled in a similar way, at a water-bath heat of 172° F. (77·6° C.); the first tenth part was set aside and the remainder kept as pure anhydrous alcohol, or as free from water as it is possible to obtain it by this process. It had a sp. gr. of ·7938 at 60° F. (15·5° C.), compared with water at the same temperature. A portion of this alcohol was subsequently digested with quicklime for three months; it was then distilled, and its specific gravity was found to be exactly the same as before."

Notwithstanding the care taken in this method, Messrs. Squibb ('Chem. News,' 1885, vol. li, pp. 7, 21, 33) have shown that alcohol prepared in this way still contains water. These gentlemen were led to make their investigation by observing that in a manufactory where large quantities of pure absolute alcohol were produced, the alcohol frequently distilled over with a density as low as ·79364 at 60° F., which was considerably below that obtained by other observers.

The method of manufacture consisted in allowing the alcohol to filter through tall columns of powdered quicklime and then distilling. This filtration and consequent freedom of the alcohol from suspended particles of lime was found to be the cause of the low density obtained, since it appears that slaked lime when heated in contact with strong alcohol parts with a portion of its water, a new equilibrium being set up between the lime and alcohol in their affinity for water. The method recommended by Messrs. Squibb is to use as a filter a tall metallic cylinder filled with

well-ignited powdered lime resting on powdered glass, and to pass and repass the alcohol through the filter for some weeks. The lime should be in large excess over the alcohol, and the filtrate should be perfectly clear and free from suspended lime before distillation, which is best conducted under reduced pressure. The alcohol thus dried is extremely hygroscopic, and undried air should be rigidly excluded. The lowest densities are obtained in cold and dry weather. The sp. gr. of this alcohol was ·7935 at 60° F. (15·5° C.), compared with water at the same temperature. This is the lowest density yet obtained; nevertheless, since the density varied slightly in different parts of the distillate, the alcohol probably still contained a trace of water.

Properties. Pure alcohol is a mobile colourless liquid, of a penetrating and agreeable odour, and pungent burning taste. It boils at 78·3° C. (173° F.). It has never been frozen. Faraday, by surrounding it with a solution of solid carbonic acid gas in ether and placing the whole in a vacuum, reduced its temperature to −107° C. (−160° F.). At this temperature it thickened but did not solidify. Its vapour density is 1·613 as compared with air, and 23·27 as compared with hydrogen (theory = 23).

When anhydrous it burns with a whitish flame, which deposits carbon on a cold surface. When mixed with water the flame is blue and deposits no soot.

Alcohol mixes in all proportions with water, heat being evolved and a contraction taking place. Thus when equal parts of proof spirit and water at 10° C. (50° F.) are mixed, the temperature of the mixture rises to 21° C. (70° F.). The contraction on mixing alcohol and water is greatest when they approximate to the formula ($C_2H_6O + 3H_2O$), *i. e.* 52·3 volumes of alcohol to 47·7 volumes of water. This mixture measures only 96·35, showing a contraction of 3·65 volumes. The following table gives the composition, specific gravity, and contraction on mixing, of mixtures of alcohol and water:

Sp. gr.	100 Measures contain Measures of		Contraction.
	Alcohol.	Water.	
1·0000	0	100·000	0·000
·9985	1	99·055	·055
·9970	2	98·111	·111
·9956	3	97·176	·176
·9942	4	96·242	·246
·9928	5	95·307	·307
·9915	6	94·382	·382
·9902	7	93·458	·458
·9890	8	92·543	·543
·9878	9	91·629	·629
·9866	10	90·714	·714
·9854	11	89·799	·799
·9843	12	88·895	·895
·9832	13	87·990	·990
·9821	14	87·086	1·086
·9811	15	86·191	1·191
·9800	16	85·286	1·286
·9790	17	84·392	1·392
·9780	18	83·497	1·497
·9770	19	82·603	1·603
·9760	20	81·708	1·708
·9750	21	80·813	1·813
·9740	22	79·919	1·919
·9729	23	79·014	2·014
·9719	24	78·119	2·119
·9709	25	77·225	2·225
·9698	26	76·320	2·320
·9688	27	75·426	2·426
·9677	28	74·521	2·521
·9666	29	73·617	2·617
·9655	30	72·712	2·712
·9643	31	71·797	2·797
·9631	32	70·883	2·883
·9618	33	69·958	2·958
·9605	34	69·034	3·034
·9592	35	68·109	3·109
·9579	36	67·184	3·184
·9565	37	66·250	3·250
·9550	38	65·305	3·305
·9535	39	64·361	3·361
·9519	40	63·406	3·406
·9503	41	62·451	3·451
·9487	42	61·497	3·497
·9470	43	60·532	3·532
·9452	44	59·558	3·558
·9435	45	58·593	3·593
·9417	46	57·618	3·618
·9399	47	56·644	3·644
·9381	48	55·699	3·699
·9362	49	54·685	3·685
·9343	50	53·700	3·700
·9323	51	52·705	3·705
·9303	52	51·711	3·711
·9283	53	50 716	3·716
·9263	54	49·722	3·722
·9242	55	48·717	3·717
·9221	56	47·712	3·712
·9200	57	46·708	3·708
·9178	58	45·693	3·693
·9156	59	44·678	3·678
·9134	60	43·664	3·664
·9112	61	42·649	3·649
·9090	62	41·635	3·635
·9067	63	40·610	3·610
·9044	64	39·586	3·586
·9021	65	38·561	3·561
·8997	66	37·526	3·526
·8973	67	36·492	3·492
·8949	68	35·457	3·457
·8925	69	34·423	3·423
·8900	70	33·378	3·378
·8875	71	32·333	3·333
·8850	72	31·289	3 289
·8825	73	30·244	3·244
·8799	74	29·190	3·190
·8773	75	28·135	3·135
·8747	76	27·080	3·080
·8720	77	26·016	3·016
·8693	78	24·951	2·951

Sp. gr.	100 Measures contain Measures of		Contraction.
	Alcohol.	Water.	
·8665	79	23·877	2·877
·8639	80	22·822	2·822
·8611	81	21·747	2·747
·8583	82	20·673	2·673
·8555	83	19·598	2·598
·8526	84	18·514	2·514
·8496	85	17·419	2·419
·8466	86	16·324	2·324
·8436	87	15·230	2·230
·8405	88	14·125	2·125
·8373	89	13·011	2·011
·8339	90	11·876	1·876
·8306	91	10·751	1·751
·8272	92	9·617	1·617
·8237	93	8·472	1·472
·8201	94	7·318	1·318
·8164	95	6·153	1·153
·8125	96	4·968	0·968
·8084	97	3·764	0·764
·8041	98	2·539	0·539
·7995	99	1·285	0·285
·7946	100	0·000	0·000

These mixtures have boiling points lying between those of their constituents (viz. 78·4° and 100° C., or 173° and 212° F.), and nearer to one or the other according to whichever constituent predominates. When they are boiled, the vapour which passes over first is richer in alcohol than the original mixture, whilst that which passes over last contains more water. With liquids very rich in alcohol, however, *i. e.* containing only 2 to 3 per cent. of water, the reverse is the case, the liquid first distilling over being comparatively poor in alcohol. The following table, by Gröning and Otto, gives the boiling points of mixtures and the composition of the condensed vapour.

Percentage of alcohol in 100 parts by volume of the boiling fluid.	Boiling temperature (temperature of the vapour).		Percentage of alcohol in 100 parts by volume of the condensed vapour.
	C.	F.	
90	78·8	174	92
80	79·4	175	90·5
70	80	176	89
60	81·3	178·3	87
50	82·5	180·5	85
40	83·8	183	82
30	85	185	78
20	87·5	189·5	71
18	88·8	192	68
15	90	194	66
12	91·3	196·3	61
10	92·5	198·5	55
7	93·8	201	50
5	95	203	42
3	96·3	205·3	36
2	97·5	207·5	28
1	98·8	210	13
0	100	212	0

The expansion of alcohol by heat is not uniform. It is most uniform, for the range of temperature from − 14° to + 98°, and amounts to ·00104 of its volume at 0° for each degree centigrade. The specific heat of alcohol is 0·615. Its latent heat of evaporation is 208·9.

Alcohol when passed through a red-hot tube is decomposed, yielding a little carbon, naphthalene, empyreumatic oil, carbonic oxide, carbonic anhydride, hydrogen, marsh gas, olefiant gas and water.

Alcohol dissolves gases more readily than water. It dissolves resins, essential oils, camphor, bitumen, soaps, sugar, carbonic and boracic acids, iodine and the iodides, ammonia, soda, potash, the alkaloids, wax and spermaceti (when boiling), and all the deliquescent salts (except potassium carbonate). It curdles milk, coagulates albumen, and (in quantity) separates both starch and gum from their solutions. Phosphorus and sulphur are sparingly soluble in alcohol.

Chlorine acts on alcohol with great energy, producing hydrochloric acid, aldehyde, acetic acid, ethyl acetate, ethyl chloride, and chloral, thus:

$$C_2H_6O + Cl_2 = 2HCl + \underbrace{C_2H_4O}_{\text{Aldehyde.}}$$

$$C_2H_6O + 4Cl_2 = 5HCl + \underbrace{C_2HCl_3O}_{\text{Chloral.}}$$

$$C_2H_6O + HCl = H_2O + \underbrace{C_2H_5Cl}_{\text{Ethyl chloride.}}$$

$$C_2H_6O + H_2O + 2Cl_2 = 4HCl + \underbrace{C_2H_4O_2}_{\text{Acetic acid.}}$$

$$C_2H_6O + C_2H_4O_2 = \underbrace{C_2H_5 \cdot C_2H_3O_2}_{\text{Ethyl acetate.}}$$

This mixture was formerly known as heavy muriatic ether. If the action of chlorine is continued for a long time, chloral is the chief product.

Iodine dissolves freely in alcohol with a brown colour. If the liquid is boiled, hydriodic acid is formed, the alcohol being oxidised. If caustic potash is present, the liquid becomes colourless, and potassium iodide and iodoform are produced, thus:

$$C_2H_6O + 4I_2 + 6KHO = \underbrace{CHI_3}_{\text{Iodoform.}} + \underbrace{KCHO_2}_{\text{Potass. formate.}} + 5KI + 5H_2O$$

Bleaching powder acts in a similar way, producing chloroform:

$$2C_2H_6O + 5CaCl_2O_2 = \underbrace{2CHCl_3}_{\text{Chloroform.}} + 2CaCO_3 + 2CaCl_2 + CaH_2O_2 + 4H_2O$$

Potassium bichromate and sulphuric acid oxidise alcohol to aldehyde, which is recognisable by its pungent odour, and at the same time the liquid turns green from the formation of chromic sulphate:

$$3C_2H_6O + K_2Cr_2O_7 + 4H_2SO_4 = 3C_2H_4O + K_2SO_4 + Cr_23SO_4 + 7H_2O$$

The same body (aldehyde) is produced by distilling alcohol with manganese dioxide and dilute sulphuric acid. Alcohol, when heated with a large excess of strong sulphuric acid, evolves olefiant gas or ethylene, through abstraction of water:

$$C_2H_6O = \underbrace{C_2H_4}_{\text{Ethylene.}} + H_2O.$$

Alcohol, added to strong sulphuric acid in molecular proportions, forms sulphovinic or ethylsulphuric acid:

$$C_2H_5OH + H_2SO_4 = (C_2H_5)HSO_4 + H_2O.$$

If this compound is distilled with excess of water, alcohol is reproduced:

$$(C_2H_5)HSO_4 + H_2O = (C_2H_5)OH + H_2SO_4;$$

but, if it is heated with more alcohol, ether is formed (see ETHERIFICATION):

$$(C_2H_5)HSO_4 + (C_2H_5)HO = (C_2H_5)_2O + H_2SO_4.$$

Concentrated nitric and chloric acids, or potassium chlorate and sulphuric acid, act violently on alcohol, oxidising it to acetic acid and other products. Hydrochloric, hydrobromic, hydriodic, formic, acetic, and oxalic acids combine with alcohol with elimination of water, forming ethers, thus:

$$C_2H_5.OH + HCl = \underbrace{C_2H_5Cl}_{\text{Ethyl chloride.}} + H_2O.$$

Alcohol can take the place of water of crystallisation in many salts, producing compounds known as alcoholates; thus, with calcium chloride it forms the compound: $CaCl_2.4C_2H_6O$.

Potassium or sodium, when added to absolute alcohol, dissolve in it with evolution of hydrogen, forming potassium or sodium ethylates (sometimes also termed alcoholates), bodies consisting of alcohol in which the hydroxylic hydrogen is replaced by the metal:

$$C_2H_5OH + Na = C_2H_5ONa + H.$$

If water is added to these compounds, caustic alkalies are produced, and the alcohol regenerated:

$$C_2H_5ONa + H_2O = C_2H_5.OH + NaHO.$$

Alcohol, as we have seen, can be produced from ethylene; it can also be obtained from its oxidation product, acetic acid. For this purpose the acetic acid is converted into acetyl chloride by distillation with phosphoric chloride, thus:

$$C_2H_3O.OH + PCl_5 = \underbrace{C_2H_3O.Cl}_{\text{Acetyl chloride.}} + POCl_3.$$

The acetyl chloride is then dissolved in anhydrous acetic acid and treated with sodium amalgam. In this reaction the sodium reacts with the acetic acid, producing sodium acetate and nascent hydrogen, which latter converts the acetyl chloride first into aldehyde and then into alcohol:

$$C_2H_3O.Cl + H_2 = C_2H_3O.H + HCl$$
$$C_2H_3O.H + H_2 = C_2H_6O.$$

The alcohol formed combines with a further quantity of acetic acid to form acetic ether, from which it can be liberated by distillation with caustic soda.

Detection and Estimation. Small quantities of alcohol may be detected by heating the liquid with potassium bichromate and moderately strong sulphuric acid. If alcohol be present, the liquid will turn green. The iodoform test is also very delicate. It is performed as follows:—A few drops of caustic soda are added to the liquid to be examined, which is then warmed to 50° C. (112° F.). A solution of iodide of potassium which has been saturated with iodine is now added gradually, until the liquid has acquired a permanent yellow-brown colour, and this colour is then removed by the cautious addition of caustic potash. If alcohol be present, a yellow crystalline powder of iodoform will be precipitated. This test will detect one part of alcohol in 2000 parts of water, but unfortunately both it and the previous test with potassium bichromate are common to a large number of organic substances, and are therefore of no use unless it is known that no other organic compound excepting alcohol is present. A more reliable test depends upon the aldehyde evolved in the first reaction, and is thus described in Allen's 'Commercial Organic Analysis': "100 c.c. of the dilute alcoholic liquid are placed in a small flask, together with 2 c.c. of a cold saturated solution of bichromate of potassium and 12 c.c. of normal sulphuric acid; a few pieces of pumice are added to prevent bumping, a bent tube attached, and 20 c.c. distilled off slowly into a graduated tube containing 3 c.c. of a syrupy solution of caustic soda. The distillate is then heated, kept at the boiling-point for a few seconds, and placed aside for two hours. If the original spirituous liquid contained ·01 per cent. of alcohol, the contents of the tube will have acquired a deep yellow colour and have deposited flocks of aldehyde resin; with ·05 per cent. no resin separates, but the fluid is deep yellow and perceptibly opalescent; with ·01 per cent. the colour is only just perceptible, but the characteristic odour is still very distinct. It is of course essential in this process that the quantity of chromic acid shall not be sufficient to convert the aldehyde into acetic acid." Another test for small quantities of alcohol consists in shaking the liquid for a few minutes with powdered gum guaiacum, filtering, adding a few drops of hydrocyanic acid, and then one drop of a weak solution of copper sulphate. If alcohol be present an intense blue will be produced.

Alcohol in quantity may be recognised by its smell, inflammability, &c. For its estimation, see ALCOHOLOMETRY. Absolute alcohol may be tested for water by adding a little ignited copper sulphate to the liquid. If water be present, the powder will turn blue. A better test consists in adding a crystal of potassium permanganate to the liquid, when, if water (·5 %) be present, a pink colour will be produced.

Small quantities of alcohol may be estimated by the method of Dupré ('Journ. Chem. Soc.,' xx, 496). For this purpose a weighed quantity of the liquid containing not more than ·2 grm. of real alcohol is diluted to 20 c.c. and placed in a small strong flask. An aqueous solution is next prepared of 10 grm. potassium bichromate and 11·8 c.c. strong sulphuric acid in 100 c.c.; 10 c.c. of this solution are added to the alcoholic liquid in the flask, which is then closed with an india-rubber cork, the latter being tied down, and the flask is then heated in boiling water for two hours.

When cold the flask is opened, and granulated zinc and sulphuric acid are added to reduce the excess of potassium bichromate. The liquid is then distilled, with the addition of pumice to prevent bumping. When nearly dry, water should be added and the distillation repeated. The distillate is titrated with decinormal soda, with phenolphthaleïn as an indicator. Before titrating, a few drops of barium chloride should be added, to test for sulphuric acid. Any precipitate should be filtered off and weighed (233 parts of barium sulphate correspond to 46 of alcohol), and this must be deducted from the result of the titration; 1 c.c. of decinormal soda is equivalent to ·0046 grm. of anhydrous alcohol. In the presence of volatile acids or fixed organic matter, the liquid must first be neutralised and distilled, the distillate being treated with potassium bichromate and sulphuric acid as before.

Distillation (after neutralisation, if the liquid contains volatile acids) suffices to separate alcohol from fixed substances, such as salts or sugar, and also from bodies of high boiling-point, such as glycerine. Where the liquid contains neutral volatile substances, a special method must be devised, according to circumstances. Compound ethers, chloroform, and ordinary ether may be removed from the distillate by shaking it with a saturated solution of calcium chloride, in which the alcohol alone dissolves. The calcium chloride solution is then separated, diluted with water, and distilled.

Examination of Commercial Spirits of Wine. This should consist of ethyl alcohol and water, but it frequently also contains higher homologues (fusel oil), aldehyde, acetic acid, resinous and oily matters, and fixed impurities.

A rapid test for the presence of fusel oil is to pour some of the liquid on to a filter-paper, placed in a plate, and allow it to evaporate. The smell of fusel oil can be detected in the last portions, especially if the plate be warmed. Allen states that a sample of gin, to which $\frac{1}{2000}$th part of amyl alcohol had been added, responded to this test.

Another plan is to add about one grm. of caustic potash to 150 c.c. of the spirit, evaporate the mixture to $\frac{1}{10}$th of its bulk, and acidulate with dilute sulphuric acid. A characteristic and frequently repulsive odour will be given off if fusel oil be present. A little experience with different spirits will enable one to recognise their source, e.g. raw grain, malt, potatoes, &c., by the smell.

Fusel oil in alcohol may be determined by the method devised by Traube ('Ber. der Deutsch. Chem. Gesellschaft,' xix, 892—895; xx, 2644—2655), which is based on the fact that, for dilute alcoholic solutions, the capillary height is inversely proportional to the density of the solution. For this purpose the density of the alcohol is determined, and it is then diluted until it contains 20% of alcohol (the fusel oil present makes practically no difference in the density). The height to which it runs in a capillary tube is then compared with that obtained with a solution of pure alcohol of 20%, and with a solution of fusel oil (in 20% alcohol) of known strength. The quantity of fusel oil present is then determined by proportion. A better method consists in counting the number of drops which are delivered when a given volume of the liquid drops from a capillary opening, and comparing this with the number obtained from the same volume of a solution of pure alcohol of the same strength, when delivered from the same apparatus. A 100 c.c. burette, furnished with a capillary opening at the lower end, can be used. The trial alcohol is diluted, as before, until it contains 20%, and the number of drops determined. The experiment is then repeated with a solution of pure alcohol of 20% strength. An excess of 1·6 drops per 100 c.c. = 0·1% fusel oil, 3·5 drops per 100 c.c. = 0·2%. 0·05% fusel oil can be determined in this way. The process becomes even more accurate if the proportion of alcohol be still further reduced. For this purpose 300 c.c. of the liquid are shaken with 110—120 grms. ammonium sulphate, and the lower layer drawn off and again shaken with a little more sulphate. The two upper layers are mixed, dissolved in water, and one third distilled off; the percentage of alcohol in the distillate is then determined, and the number of drops observed. Pure alcohol of the same strength, containing a known amount of fusel oil, is then allowed to drip through the apparatus, and the results compared as before. The apparatus is known as the 'stalagmometer.'

Fixed impurities may be detected by evaporating the liquid. Burnt sugar, aromatic substances, and resins would give characteristic odours on heating the residue. The inorganic substances can be separated by igniting the residue. Oily and resinous substances are precipitated on diluting the liquid, rendering it milky. If acetic or other acid be present, the spirit will have an acid reaction.

Aldehyde is frequently present in small quantities in commercial alcohols. The addition of silver nitrate, with exposure to daylight, is a delicate test for this substance, metallic silver being precipitated. The British Pharmacopœia directs that 30 fl. gr. (2 c.c.) of decinormal silver nitrate be added to 4 fl. oz. of the liquid, which is then exposed to daylight for twenty-four hours. At the end of this time the liquid is decanted from the black precipitate, and the treatment repeated; if with negative results, the spirit is satisfactory. Aldehyde, present in moderate quantity, causes the alcohol to turn brown when heated with caustic soda.

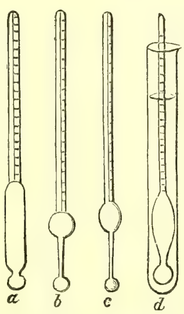
Wood spirit, if suspected, can be detected by testing for acetone by the method of J. E. Reynolds:—"Take 200 c.c. of the spirit and rapidly distil off 50 c.c.; dilute the distillate with an equal volume of water, and slightly warm, with addition of a few c.c. of solution of potassium hydrate. On cautious addition of mercuric chloride the oxide, at first thrown down, is speedily redissolved; excess of the mercuric salt must be carefully avoided. The alkaline liquid should be filtered clear, much of the alcohol allowed to evaporate slowly, and the residue then divided into two portions. One part is to be violently boiled for a few minutes; a yellowish-white gela tinous precipitate will suddenly make its appearance if the acetone compound be present. In the second portion, dilute acetic acid, when added in excess, should produce a bulky, white, gelatinous

precipitate, containing, when washed and completely dried, between 78% and 79% of mercury." A boiling point below 77° C. (170° F.) would also suggest wood spirit.

For analysis of wood spirit see WOOD-SPIRIT.

Uses. In the *arts,* alcohol is used by the varnish-maker to dissolve resins; by the perfumer to extract the odours of plants and to dissolve essential oils, soaps, and other similar substances; by the pharmaceutist to prepare tinctures and other valuable medicinals; by the instrument-maker to fill the bulbs of thermometers required to measure extremely low temperatures; by the photographer for the preparation of collodion; by the chemist, in analysis and in the manufacture of numerous preparations; by the naturalist and anatomist as an antiseptic; and by the physician, for various purposes and applications as a remedy. It is also frequently burnt in lamps, and in parts of the world where it is inexpensive it is employed in the manufacture of vinegar. Its uses, when dilute, as in the 'spirituous liquors' of commerce, are well known. In *medicine,* it is employed both concentrated ('alcohol,' 'rectified spirit') and dilute ('proof spirit,' 'brandy,' 'gin,' &c.) as a caustic, irritant, stimulant, tonic, &c. It has also been used in a multitude of other cases, and has been applied to an almost infinite variety of other purposes.

ALCOHOLOMETER. (See Fig.) A 'hydrometer' graduated so as to represent the proportion of pure alcohol by weight or by volume, and of alcohol of given strength (proof spirit) present in the liquid to be tested. Some of these (*Baumé's, Carter's,* &c.) are graduated with an arbitrary scale, which gives the percentage of alcohol on reference to tables constructed for the purpose. Others ((*a*) *Richter's,* (*b*) *Tralles',* and (*c*) *Gay-Lussac's*) have the proportion of alcohol marked on their stems. These, of course, can only be used at the standard temperature for which they are graduated.



a *b* *c* *d*

Instruments have also been constructed for the determination of alcohol, based on (1) the boiling-point, (2) the rate of expansion, and (3) the vapour-tension of mixtures of alcohol and water; but they are not in general use.

ALCOHOLOMETRY. The process of determining (by observation of sp. gr.) the percentage of pure alcohol in a spirituous liquid, or, more generally, the percentage of alcohol of known strength (proof spirit).

History, &c. The accurate determination of the sp. gr. of alcoholic liquids of known strength is of great importance, since the duties levied on spirituous liquors are based on the content of alcohol as determined by sp. gr. observations. The first accurate determinations of the densities of mixtures of alcohol and water are those of Blagden and Gilpin ('Phil. Trans,' 1790, p. 321; 1792, pp. 425, 439; 1794, p. 275), made at the request of the British Government. These observers used almost every precaution which even the science of the present day could demand, and their results form the basis of the tables now in use. Their determinations were made by direct weighings, and the only correction omitted was the reduction of the weighings to their values in a vacuum. This correction, however, never amounts to more than ·0001 on the sp. gr. Blagden and Gilpin did not use absolute alcohol in their experiments, but an alcohol of sp. gr. ·82514, reduced by calculation to ·825 at 60° F., water at 60° F. being taken as unity.

In 1811, at the request of the Prussian Government, Tralles, the secretary of the Academy of Sciences at Berlin, undertook a re-examination of the subject, and his results form the basis of the tables used on the Continent. On examining the experiments of Blagden and Gilpin, he found them so perfect that he decided to make them the basis of his tables, contenting himself with reducing the results to the absolute alcohol of his day. This was that of Lowitz, which had a sp. gr. of ·791 at 15° R. (68° F.) (water = 1 at the same temperature). This value, calculated at 60° F. against water at the same temperature, gives ·7942 as the sp. gr. of Lowitz alcohol. Tralles seems, however, to have taken a smaller co-efficient of expansion for alcohol than he actually found, and he gives ·7946 for the sp. gr. of alcohol at 60° F. (water at 60° F. = 1).

Tralles next determined by a series of experiments the percentage of his alcohol in Gilpin's alcohol of ·825 sp. gr.; he found that the latter contained 92·6% (by volume) and 89·2% (by weight).

Of other investigations, the best known is that of Fownes ('Phil. Trans.,' 1847, p. 249) "On the Value in Absolute Alcohol of Spirits of Different Specific Gravity." Fownes used absolute alcohol of sp. gr. ·7938 at 60° F. The experiments were made by weighing out quantities of alcohol and water, mixing them in stoppered bottles, and taking the sp. gr. of the mixture after three or four days. No data are given of the precautions observed or corrections made in these experiments; and, further, the standard taken—whether water at 60° F. or at 4° C.—is not stated. Hence the tables of Blagden and Gilpin are to be preferred. The latter are confirmed by the experiments of Drinkwater ('Phil. Mag.,' xxii, 1848, p. 123).

The above historical review is taken from 'A Treatise on Alcohol,' by Thomas Stevenson, M.D., (Gurney and Jackson, 1st ed., 1880; 2nd ed., 1888).

Proof Spirit. Proof spirit is defined by Statute (58 Geo. III, c. 28) as "that which at a temperature of 51° by Fahrenheit's thermometer weighs exactly $\frac{12}{13}$th's of an equal measure of distilled water." It is assumed, though not enacted, that the water is likewise at a temperature of 51° F. Hence the sp. gr. of proof spirit at 51° F. is ·92308, when compared with water at the same temperature.

Drinkwater calculated the sp. gr. of proof spirit from Gilpin's experiments, and found ·91984 at 60° F., compared with water at the same temperature. He found that proof spirit contained 49·24% by weight, or 57·06% by volume of absolute alcohol (sp. gr. ·7938, 60°/60°), = 49·19

and 57·01 respectively for alcohol of ·7935 sp. gr.

As we have already seen, the complete dehydration of alcohol is a matter of difficulty. The following are the more reliable results hitherto obtained:

Fownes . . .	·7938 at 60° F. compared with water at 60° F.
Mendelejeff . .	·79367 at 15° C. compared with water at 4° C.
Dupré & Page .	·79317 at 15·5° C. compared with water at 4° C.
Drinkwater . .	·79381 at 60° F. compared with water at 60° F.
Messrs. Squibb .	·79350 at 60° F. compared with water at 60° F.

Drinkwater's value is the one usually taken. In order to convert percentage by weight of alcohol of ·7938 into percentage of alcohol of ·7935, $\frac{1}{1000}$th of the value must be deducted. Thus spirit which contains 90·% of alcohol of sp. gr. ·7938 will contain 90· – ·09 = 89·91%.

In commerce spirituous liquors are usually spoken of as so much per cent., or so many degrees over or under proof, the value representing the amount of concentration or dilution which the liquid must undergo in order to convert it into proof spirit. Thus, by a spirit of 20% or 20 degrees u. p., is meant a liquid containing 80 volumes of proof spirit in 100 volumes of the liquid, whilst a liquid of 50 degrees o. p. would be one of which 100 volumes would have to be diluted to 150 volumes to render it proof (the amount of water to be added would be more than 50 volumes, owing to the contraction which takes place on mixing.) See ALCOHOL.

In the United States Tralles' tables are legalised, and the proportion of alcohol is usually stated in volumes of absolute alcohol; a proof spirit is, however, recognised, and is defined as "that alcoholic liquor which contains one half its volume of alcohol of ·7939 sp. gr. at 60° F." This spirit has a sp. gr. of ·93353 at 60° F. (water at 4° C. = 1), or ·9341 at 60° F. (water at 60° F. = 1), and contains 42·7% of absolute alcohol (of ·7938 sp. gr.).

Rectified spirit is the strongest alcohol obtainable by simple distillation. The rectified spirit of the B. P. has a density of ·838, and contains 84% by weight of pure alcohol. The proof spirit of the B. P. has a density of ·920, and contains 49% by weight of real alcohol.

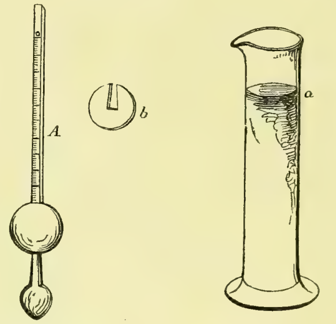
In the United States Pharmacopœia three different strengths of alcohol are recognised, namely, (1) 'absolute alcohol;' (2) 'alcohol' of ·820 sp. gr. = 91% by weight; and (3) 'diluted alcohol,' of ·928 sp. gr., made with equal measures of 'alcohol' (No. 2) and water. This preparation corresponds closely to 'proof spirit,' B. P. The 'spirit' of the German Pharmacopœia has a density of ·830 to ·834, corresponding pretty closely to 'rectified spirit,' B. P. The 'dilute spirit' has a density of ·892 to ·896 (*Allen*).

ALCOHOLOMETRY, METHODS OF. The determination of the amount of alcohol by weight or volume, or of the amount of proof spirit in an alcoholic liquid, is usually effected by observing the sp. gr. of the latter, and then obtaining the above data corresponding to this value from tables constructed on Blagden and Gilpin's experiments.

It is obvious that only in the case of pure spirits of wine or of unsweetened spirits can the sp. gr. be taken directly. If fixed substances are in solution, the alcohol must first be separated from them by distillation.

Determination of Alcohol without previous distillation.

I. *By Sykes' Hydrometer.* This instrument, as is seen from the annexed figure, is a form of



hydrometer, usually made of brass, sometimes gilded. The upper part (*A*) is divided into ten parts, each of which contains five subdivisions. In order to extend the range of the instrument, a number of brass weights (*b*) are provided, which are slipped on to the lower part of the stem. The instrument thus becomes equivalent to a number of hydrometers with differently weighted bulbs, or to one hydrometer with a very long stem. The weights are marked 10, 20, 30, &c., up to 90, each of which represents as many of the principal divisions of the stem as its number indicates. In use, one of these weights is slipped on to the lower stem; and thus, by means of them, the instrument acquires a range of above 500 divisions, or degrees, extending from the revenue 'standard alcohol' (sp. gr. ·825) to water. It is so formed as to give the sp. gr. with almost perfect accuracy at 62° F. When loaded with the weight 60, it sinks in proof spirit at 51° F. to the line marked "P" on the narrow edge of the stem (see PROOF SPIRIT, STATUTE); and by further placing the square weight or cap (also supplied with the instrument) on the top of the upper stem, it floats at exactly the same point in distilled water at 51° F. This cap is exactly $\frac{1}{12}$th of the weight of the instrument together with the weight 60, and the instrument is thus checked as per statute.

In order to use the instrument the glass cylinder is filled with the liquid to be tested, and the hydrometer, with a suitable weight attached, is immersed in the liquid so that the surface of the latter cuts the stem at some part of its graduation. The instrument is depressed to the 0° mark, so as to wet the stem, and is then allowed to come to rest, when the reading is taken. In doing this, allowance must be made for the convexity of the liquid, the reading being taken at the surface of the latter. In the determination of a sp. gr., the temperature is of course a matter of importance, owing to the expansion which

Table I.—*Showing the Densities and Values of Spirits at 60° Fahr., corresponding to every Indication of Sykes' Hydrometer.*

Sykes' Hydrometer Indication.	Strength per cent.	Specific Gravity.	Per Cents. of Absolute Alcohol.		Sykes' Hydrometer Indication.	Strength per cent.	Specific Gravity.	Per Cents. of Absolute Alcohol.	
			By Measure.	By Weight.				By Measure.	By Weight.
	O. P.					O. P.			
0	67·0	·81520	95·28	92·78	51	11·4	·90551	63·54	55·70
1	66·1	·81715	94·78	92·08	52	10·0	·90732	62·74	54·89
2	65·3	·81889	94·31	91·42	53	8·6	·90913	61·94	54·09
3	64·5	·82061	93·84	90·78	54	7·1	·91107	61·09	53·23
4	63·6	·82251	93·33	90·07	55	5·6	·91299	60·24	52·38
5	62·7	·82441	92·80	89·36	56	4·2	·91479	59·43	51·57
6	61·8	·82622	92·29	88·67	57	2·7	·91666	58·58	50·73
7	60·9	·82800	91·77	87·99	58	1·3	·91839	57·78	49·94
8	60·0	·82978	91·25	87·30		U. P.			
9	59·1	·83151	90·74	86·63	59	0·3	·92037	56·86	49·04
10	58·2	·83323	90·23	85·96	60	1·9	·92228	55·96	48·17
11	57·3	·83494	89·72	85·30	61	3·4	·92408	55·10	47·33
12	56·4	·83661	89·21	84·65	62	5·0	·92597	54·19	46·46
13	55·5	·83827	88·70	84·00	63	6·7	·92798	53·22	45·53
14	54·6	·83993	88·17	83·33	64	8·3	·92984	52·30	44·65
15	53·7	·84153	87·67	82·70	65	10·0	·93176	51·36	43·76
16	52·7	·84331	87·10	81·99	66	11·7	·93367	50·39	42·84
17	51·7	·84509	86·51	81·26	67	13·5	·93586	49·34	41·86
18	50·7	·84680	85·95	80·58	68	15·3	·93758	48·31	40·90
19	49·7	·84851	85·39	79·89	69	17·1	·93949	47·29	39·96
20	48·7	·85022	84·81	79·19	70	18·9	·94135	46·29	39·04
21	47·6	·85205	84·19	78·44	71	20·8	·94327	45·20	38·04
22	46·6	·85372	83·61	77·74	72	22·7	·94518	44·09	37·03
23	45·6	·85537	83·04	77·07	73	24·7	·94709	42·96	36·01
24	44·6	·85700	82·47	76·39	74	26·7	·94899	41·82	34·98
25	43·5	·85878	81·85	75·66	75	28·8	·95092	40·63	33·92
26	42·4	·86055	81·21	74·92	76	31·0	·95288	39·40	32·82
27	41·3	·86229	80·59	74·19	77	33·2	·95484	38·10	31·68
28	40·2	·86402	79·97	73·47	78	35·6	·95677	36·76	30·50
29	39·1	·86574	79·34	72·75	79	38·1	·95877	35·32	29·24
30	38·0	·86745	78·71	72·03	80	40·6	·96068	33·90	28·01
31	36·9	·86915	78·08	71·32	81	43·3	·96259	32·41	26·73
32	35·7	·87099	77·40	70·54	82	46·1	·96457	30·77	25·32
33	34·5	·87282	76·71	69·77	83	49·1	·96651	29·08	23·88
34	33·4	·87450	76·08	69·06	84	52·2	·96846	27·31	22·38
35	32·2	·87627	75·41	68·32	85	55·5	·97049	25·39	20·77
36	31·0	·87809	74·72	67·55	86	59·0	·97254	23·41	19·11
37	29·8	·87988	74·03	66·79	87	62·5	·97458	21·39	17·42
38	28·5	·88179	73·29	65·98	88	66·0	·97660	19·41	15·78
39	27·3	·88355	72·60	65·23	89	69·4	·97857	17·46	14·16
40	26·0	·88544	71·86	64·43	90	72·8	·98057	15·51	12·56
41	24·8	·88716	71·17	63·68	91	76·1	·98261	13·58	10·97
42	23·5	·88901	70·43	62·89	92	79·2	·98452	11·85	9·56
43	22·2	·89086	69·69	62·10	93	82·3	·98657	10·04	8·08
44	20·9	·89268	68·95	61·32	94	85·2	·98866	8·28	6·65
45	19·6	·89451	68·21	60·53	95	88·0	·99047	6·83	5·48
46	18·3	·89629	67·47	59·76	96	90·7	·99251	5·25	4·20
47	16·9	·89822	66·67	58·92	97	93·3	·99448	3·80	3·03
48	15·6	·89997	65·93	58·15	98	95·9	·99658	2·31	1·84
49	14·2	·90182	65·14	57·34	99	98·2	·99851	·997	·793
50	12·8	·90367	64·34	56·52	100	...	1·00000	...	...

This Table has been copied, by permission, from Loftus's 'Inland Revenue Officer's Manual,' and its correctness verified by W. H. Johnston, Esq., Surveying General Examiner.

liquids undergo when heated; hence the temperature of the liquid must first be taken with an accurate thermometer. In the book usually furnished with Sykes' hydrometer, separate tables are given for different temperatures, and in this case it is only necessary to consult that table which corresponds to the temperature, and read off the sp. gr. or value in proof spirit corresponding to the number on the hydrometer. If the tables are constructed for one temperature (60° F.) only, the alcoholic liquid must be brought to this temperature before the determination can be made. This can be effected by placing the cylinder in cold water and noting the temperature of the spirit from time to time. When the standard temperature is reached, the density determination is made. If the water available is not sufficiently cold, it can be cooled artificially by the addition of a few crystals of sodium hyposulphite ($Na_2S_2O_3$), or of ammonium nitrate (NH_4NO_3). In employing the instrument, the Revenue Officers are instructed to take the nearest degree above the surface of the mercury, when it stands between any two degrees of the thermometer; and the division on the scale of the hydrometer next below the surface of the liquid, when it cuts the stem between any two lines; thus giving the difference in favour of the trader in both cases.

II. *With glass alcoholometers.* That of Tralles is graduated to give percentage, by volume, of alcohol at 60° F. (15·5° C.). Gay-Lussac's gives the same values at 59° F. (15° C.). These instruments must, of course, be used at the temperatures indicated, unless a table of corrections is at hand. Such a table is usually furnished along with Gay-Lussac's instrument. The process is exactly the same as before, the percentage being read directly from the stem. A series of instruments is usually supplied, representing successive ranges of density.

III. *By determination of Specific Gravity:*

a. By means of an ordinary hydrometer. The specific gravity is taken in the usual way. The liquid must first be cooled to the standard temperature (60° F. for the appended tables), unless tables for various temperatures are at hand.

b. By means of the specific gravity bottle (see SPECIFIC GRAVITY). This is undoubtedly the most accurate method for determining alcohol in the laboratory. The bottle is filled with the spirit to be tested, and is placed for some time in water at the standard temperature. The stopper is then inserted, and the bottle at once weighed.

$$\frac{\textit{Weight of liquid contained by bottle}}{\textit{Weight of water contained by bottle}} = \textit{sp. gr.}$$

Neither the counterpoise nor the value for the water-contents marked on the bottle should be taken as accurate, but the bottle should be carefully filled with distilled water at the standard temperature and weighed.

A more convenient form of bottle is one having a small thermometer passing through the stopper. By this means one is certain that the alcohol in the bottle has the right temperature. The annexed table gives a rough correction for temperature, for mixtures of alcohol and water.

Example. If a quantity of spirit is of sp. gr. 894 at 73° F., what will be its sp. gr. at 60° F.?

Here the sp. gr. being between 890 and 900, we must add ·450 for each degree of temperature between 73° and 60°. The sp. gr. at 60° would therefore be 894 + (·450 × 13) = 899·85.

TABLE II.—*Table for finding the Specific Gravity of any spirit at 60° F. when the specific gravity at any other temperature is given.*

Water taken at 1000.

Specific gravity.	Correction for each degree.
810 to 820	± ·475
820 „ 830	„ ·473
830 „ 840	„ ·472
840 „ 850	„ ·471
850 „ 860	„ ·471
860 „ 870	„ ·466
870 „ 880	„ ·460
880 „ 890	„ ·456
890 „ 900	„ ·450
900 „ 910	„ ·442
910 „ 920	„ ·434
920 „ 930	„ ·424
930 „ 940	„ ·406
940 „ 950	„ ·381
950 „ 960	„ ·340
960 „ 970	„ ·269
970 „ 980	„ ·165
980 „ 990	„ ·090
990 „ 1000	„ ·084

When the temperature is below 60°, the correction for each degree must be subtracted.

More generally the sp. gr. at any other temperature may be converted into sp. gr. at 60° F. (15·5° C.) by means of the formula:

$$D = D^1 \pm d\ (\cdot 00014 \times \frac{1 - D^1}{150})$$

where D^1 is the observed density;
D the density at 15·5° C.;
d the difference between the temperatures (on the centigrade scale);
the + sign is taken when the temperature of the experiment is above 15·5°, the − sign when it is below 15·5° C.

If in Table I the sp. gr. found does not occur, its value in per cent. by weight, &c., can be found by proportion. Thus, suppose the spirit examined to have a sp. gr. of ·96051, from the table we get:

Sp. gr. ·95877 = 35·32 % by vol.
„ ·96068 = 33·90 „ „

then

$$(\cdot 96068 - \cdot 95877 : (\cdot 96068 - \cdot 96051) :: (35\cdot 32 - 33\cdot 90) : x$$
$$x = \cdot 126$$

∴ per cent. by vol. corresponding to sp. gr. ·96051 = 33·90 + ·126 = 34·026.

The following data are useful:

Let W = per cent. of alcohol by weight
V = „ „ vol.
P = „ proof spirit by vol.
D = specific gravity

then

$$a.\ V = P \times 0\cdot 5706$$

$$b.\ V = \frac{WD}{0\cdot 7938} = WD \times 1\cdot 26$$

$$c.\ P = \frac{V}{0{\cdot}5706} = V \times 1{\cdot}7525$$

$$d.\ P = WD \times 2{\cdot}208$$

$$e.\ W = \frac{P}{D \times 2{\cdot}208}$$

$$f.\ W = \frac{V \times 0{\cdot}7938}{D}$$

When it is required to calculate the proportion of proof, or any other strength of spirit which a particular sample of alcohol contains, or would contain when diluted, the following formula should be used:

Percentage of Proof Spirit in Alcohol required × 100 ÷ *Percentage of Proof Spirit in sample* = *The number of volumes of the stronger spirit which will produce or be contained in* 100 *measures of the more dilute spirit.*

Thus, if it be required to know what percentage of gin of 20° u. p. is contained in a watered sample of 44° u. p. the following calculation will suffice:

$$\frac{56 \times 100}{80} = 70\% \text{ by vol.}$$

Hence the sample is of a strength corresponding to the dilution of 7 galls. of gin at 20° u. p. to 10 galls., by addition of water.

Again, to ascertain the proportion of water which must be added to spirit at 35° o. p. to reduce the strength to 10° u. p.:

$$\frac{90 \times 100}{135} = 66{\cdot}7.$$

That is, to obtain spirit of 10° u. p., 66·7 measures of spirit at 35° o. p. must be diluted to 100, or every two gallons must be made up to three by addition of water. (*Allen.*)

All the preceding methods for determining the percentage of alcohol, by means of the sp. gr., have supposed the absence of fixed matters which would affect the density. If these are present, as in sweetened spirits, wines, and beers, it is necessary to distil the liquid, and take the sp. gr. of the distillate.

For this purpose 50 c. c., or, in the case of wines or beers, 100 c. c., are accurately measured, care being taken that the liquid is at 60° F. (15·5° C.); any free acid is then neutralised by the addition of dilute caustic soda until the liquid is faintly alkaline, about ·1 grm. tannin added, to prevent frothing, and the liquid diluted to 150 c. c. It is next placed in a flask or retort connected with a well-cooled condenser and distilled, the operation being arrested when nearly 100 c. c. have passed over. The distillate is then cooled down to 60° F., and distilled water added until it measures exactly 100 c. c. The percentage of proof spirit or alcohol is now estimated in this liquid by Sykes' hydrometer, specific gravity determination, or other means. If the amount originally taken was 50 c. c., the percentage found must be multiplied by 2.

If by accident more than 100 c. c. have distilled over, the volume of the distillate must be noted, and the amount of alcohol in it determined; then:

Percentage by vol. of alcohol × $\dfrac{\textit{vol. of distillate}}{\textit{vol. of liquid taken}}$ = *percentage by vol. in sample.*

The percentage by weight in the sample is given by the following formula:

(*Density of Distillate* × *measure of Distillate in c. c.* × *per cent. by Weight of Alcohol found in Distillate by Table*) ÷ (*Density of sample* × *measure of sample taken in c. c.*) = *percentage of absolute alcohol by weight contained in the sample.*

This requires a determination of the sp. gr. of the original liquid. A very good plan by which this determination may be avoided is to *weigh* the liquid taken. This value is then substituted for the denominator in the above fraction.

In the case of strong spirituous liquids, the sample may be advantageously diluted to four times instead of three times the original bulk, the boiling being continued until three fourths have passed over. In estimating small quantities of alcohol, the receiver is advantageously fitted air-tight to the condenser, a safety tube being added to allow the air to expand.

Revenue Method. The following is the method adopted in the Inland Revenue and Customs laboratories for the estimation of the percentage of alcohol in wines, liquors, &c.: A measure flask is filled up to a mark on its neck with the wine, which is then carefully transferred to a distilling flask or retort, the traces of wine remaining in the former vessel being rinsed out with small quantities of distilled water, and the rinsings added to the wine in the latter vessel. About two-thirds of the contents of the retort are then distilled over into the clean measure flask, and made up to the original bulk with distilled water, at the same temperature as that of the sample previous to distillation. The strength is then taken by Sykes' hydrometer, and this (if u. p.) deducted from 100, gives the percentage of proof spirit in the wine. Thus: Strength of distillate = 74·6 u. p. = 25·4% proof spirit.

Indirect Method. The following method devised by Taberie gives very fair (slightly low) results for wine and beer, and does not require a distilling apparatus:

The sp. gr. of the original liquid is first determined. A portion—100 c. c. for instance—is then measured (at 60° F.) and boiled until all the alcohol has been expelled. The liquid is then cooled and diluted to its original bulk (at 60° F.) and the sp. gr. again taken; then:

$\dfrac{\textit{Sp. gr. of original liquid}}{\textit{sp. gr. of the extract}}$ = *sp. gr. of the alcohol evaporated when diluted to original vol.*; from this, by reference to the tables, the percentage of alcohol can be found.

Proof Spirit in given Weights of Spirit. The spirituous liquors of commerce being sold by measure, and not by weight, the methods which give the results in per cent. by volume are those chiefly used. By weight, however, the percentage of alcohol remains the same for all temperatures, for the same sample; whilst by volume, the percentage and total bulk varies with the temperature of the liquid. This variation explains the cause of many of the sudden apparent decreases and increases which occur in large stocks of spirits.

Persons purchasing spirits during very warm weather, and paying for them according to their apparent quality and strength, lose considerably by selling the same spirit when the weather becomes colder.

A consideration of these facts has led some of the great houses to introduce the system of weighing their spirits, instead of measuring them. This is the method adopted by the Inland Revenue at all distilleries for the purpose of assessing the duty. The weight of the spirit being known, its volume in gallons at a temperature of 60° F. can be obtained from the following table. To take an example:

	cwts.	qrs.	lbs.
Gross weight of full cask . .	13	2	27
Tare	2	2	5
Net weight of spirit	11	0	22

or 1254 lbs. Let us suppose the hydrometer indication to be 43·0 (at 60° F.), then the weight of a gallon (measured at 60°) would be 8·903 lbs. (see Table III). Hence the volume of the 1254 lbs. of spirit at the standard temperature (60° F.) would be $\frac{1254}{8{\cdot}903} = 140$ gallons. And at this value it is sold.

TABLE III.—*Table for determining the Weight per Gallon of Spirits by Sykes' Hydrometer.*

Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.
0	8·145	9		18		27		36	
2	8·157	2	8·309	2	8·464	2	8·620	2	8·781
4	8·161	4	8·313	4	8·467	4	8·624	4	8·784
6	8·164	6	8·316	6	8·471	6	8·628	6	8·788
8	8·168	8	8·320	8	8·474	8	8·631	8	8·791
1	8·171	10	8·323	19	8·478	28	8·635	37	8·795
2	8·174	2	8·326	2	8·481	2	8·639	2	8·799
4	8·178	4	8·330	4	8·485	4	8·642	4	8·802
6	8·181	6	8·333	6	8·488	6	8·646	6	8·806
8	8·185	8	8·337	8	8·492	8	8·649	8	8·809
2	8·188	11	8·340	20	8·495	29	8·653	38	8·813
2	8·191	2	8·343	2	8·498	2	8·656	2	8·817
4	8·195	4	8·347	4	8·502	4	8·660	4	8·820
6	8·198	6	8·350	6	8·505	6	8·663	6	8·824
8	8·202	8	8·354	8	8·509	8	8·667	8	8·827
3	8·205	12	8·357	21	8·512	30	8·670	39	8·831
2	8·208	2	8·361	2	8·516	2	8·674	2	8·835
4	8·212	4	8·364	4	8·519	4	8·677	4	8·838
6	8·215	6	8·368	6	8·523	6	8·681	6	8·842
8	8·219	8	8·371	8	8·526	8	8·684	8	8·845
4	8·222	13	8·375	22	8·530	31	8·688	40	8·849
2	8·225	2	8·378	2	8·533	2	8·692	2	8·853
4	8·229	4	8·382	4	8·537	4	8·695	4	8·856
6	8·232	6	8·385	6	8·540	6	8·699	6	8·860
8	8·236	8	8·389	8	8·544	8	8·702	8	8·863
5	8·239	14	8·392	23	8·547	32	8·706	41	8·867
2	8·242	2	8·395	2	8·551	2	8·709	2	8·871
4	8·245	4	8·399	4	8·554	4	8·713	4	8·874
6	8·249	6	8·402	6	8·558	6	8·716	6	8·878
8	8·252	8	8·406	8	8·561	8	8·720	8	8·881
6	8·255	15	8·409	24	8·565	33	8·723	42	8·885
2	8·258	2	8·412	2	8·568	2	8·727	2	8·889
4	8·262	4	8·416	4	8·572	4	8·730	4	8·892
6	8·265	6	8·419	6	8·575	6	8·734	6	8·896
8	8·269	8	8·423	8	8·579	8	8·737	8	8·899
7	8·272	16	8·426	25	8·582	34	8·741	43	8·903
2	8·275	2	8·429	2	8·586	2	8·745	2	8·907
4	8·279	4	8·433	4	8·589	4	8·748	4	8·911
6	8·282	6	8·436	6	8·593	6	8·752	6	8·914
8	8·286	8	8·440	8	8·596	8	8·755	8	8·918
8	8·289	17	8·443	26	8·600	35	8·759	44	8·922
2	8·292	2	8·446	2	8·603	2	8·763	2	8·926
4	8·296	4	8·450	4	8·607	4	8·766	4	8·929
6	8·299	6	8·453	6	8·610	6	8·770	6	8·933
8	8·303	8	8·457	8	8·614	8	8·773	8	8·936
9	8·306	18	8·460	27	8·617	36	8·777	45	8·940

TABLE III—*continued.*

Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.	Indication on Sykes' Hydrometer.	Weight per Gallon.
45		56		67		78		89	
2	8·944	2	9·147	2	9·356	2	9·569	2	9·785
4	8·947	4	9·151	4	9·360	4	9·573	4	9·789
6	8·951	6	9·154	6	9·363	6	9·576	6	9·792
8	8·954	8	9·158	8	9·367	8	9·580	8	9·796
46	8·958	57	9·162	68	9·371	79	9·584	90	9·800
2	8·962	2	9·166	2	9·375	2	9·588	2	9·804
4	8·965	4	9·170	4	9·379	4	9·592	4	9·808
6	8·969	6	9·173	6	9·382	6	9·596	6	9·812
8	8·972	8	9·177	8	9·386	8	9·600	8	9·816
47	8·976	58	9·181	69	9·390	80	9·604	91	9·820
2	8·980	2	9·185	2	9·394	2	9·608	2	9·824
4	8·984	4	9·189	4	9·398	4	9·612	4	9·828
6	8·987	6	9·192	6	9·401	6	9·615	6	9·832
8	8·991	8	9·196	8	9·405	8	9·619	8	9·836
48	8·995	59	9·200	70	9·409	81	9·623	92	9·840
2	8·999	2	9·204	2	9·413	2	9·627	2	9·844
4	9·002	4	9·207	4	9·417	4	9·631	4	9·848
6	9·006	6	9·211	6	9·420	6	9·635	6	9·852
8	9·009	8	9·214	8	9·424	8	9·639	8	9·856
49	9·013	60	9·218	71	9·428	82	9·643	93	9·860
2	9·017	2	9·222	2	9·432	2	9·647	2	9·864
4	9·021	4	9·226	4	9·436	4	9·651	4	9·868
6	9·024	6	9·229	6	9·440	6	9·655	6	9·872
8	9·028	8	9·233	8	9·444	8	9·659	8	9·876
50	9·032	61	9·237	72	9·448	83	9·663	94	9·880
2	9·036	2	9·241	2	9·452	2	9·667	2	9·884
4	9·039	4	9·245	4	9·456	4	9·671	4	9·888
6	9·043	6	9·248	6	9·459	6	9·674	6	9·892
8	9·046	8	9·252	8	9·463	8	9·678	8	9·896
51	9·050	62	9·256	73	9·467	84	9·682	95	9·900
2	9·054	2	9·260	2	9·471	2	9·686	2	9·904
4	9·058	4	9·264	4	9·475	4	9·690	4	9·908
6	9·061	6	9·267	6	9·479	6	9·694	6	9·913
8	9·065	8	9·271	8	9·483	8	9·698	8	9·917
52	9·069	63	9·275	74	9·487	85	9·702	96	9·921
2	9·073	2	9·279	2	9·491	2	9·706	2	9·925
4	9·076	4	9·283	4	9·495	4	9·710	4	9·929
6	9·080	6	9·286	6	9·498	6	9·714	6	9·934
8	9·083	8	9·290	8	9·502	8	9·718	8	9·938
53	9·087	64	9·294	75	9·506	86	9·722	97	9·942
2	9·091	2	9·298	2	9·510	2	9·726	2	9·946
4	9·095	4	9·302	4	9·514	4	9·730	4	9·950
6	9·098	6	9·305	6	9·517	6	9·733	6	9·955
8	9·102	8	9·309	8	9·521	8	9·737	8	9·959
54	9·106	65	9·313	76	9·525	87	9·741	98	9·963
2	9·110	2	9·317	2	9·529	2	9·745	2	9·967
4	9·114	4	9·321	4	9·533	4	9·749	4	9·972
6	9·117	6	9·324	6	9·537	6	9·753	6	9·976
8	9·121	8	9·328	8	9·541	8	9·757	8	9·981
55	9·125	66	9·332	77	9·545	88	9·761	99	9·985
2	9·129	2	9·336	2	9·549	2	9·765	2	9·989
4	9·132	4	9·340	4	9·553	4	9·769	4	9·994
6	9·136	6	9·344	6	9·557	6	9·773	6	9·998
8	9·139	8	9·348	8	9·561	8	9·777	8	10·003
56	9·143	67	9·352	78	9·565	89	9·781	100	10·007

*** For further information in connection with *Alcoholometry* see ALCOHOL, BEER, BREWING, DISTILLATION, HYDROMETER, HYDROMETRY, LIQUEURS, MALT-LIQUORS, SACCHARINE, SPECIFIC GRAVITY, SPIRIT, SUGAR, SYRUPS, TINCTURES, WINE, WORT, &c., &c.

ALCOHOL, PHYSIOLOGICAL EFFECTS OF. Rectified spirit or absolute alcohol dropped upon the skin produces a sense of coolness due to its rapid evaporation: if the application be continued it acts as an irritant, and produces this effect at once upon a mucous membrane; its affinity for water is probably the cause.

Alcohol even when diluted is powerfully antiseptic, and will prevent the development of organisms. Absolute alcohol will kill bacteria, vibrios, and the like, apparently by dehydrating them, if the action be prolonged.

The general effects of alcohol upon the human organism when taken in large quantities are only too well known; our information regarding the effect of *small* doses is very scanty and uncertain.

A small quantity slightly diluted promotes the functional activity of the heart and the brain; the same quantity largely diluted has only a limited influence. When taken regularly it is assimilated and oxidised in the body, and to this extent acts as a producer of heat and force, and to some extent saves the consumption of the carbohydrates and hydrocarbons of the body, which will explain the fact that many persons on taking alcohol as a regular article of diet put on fat, or more correctly do not consume the fat which their organisms ordinarily produce. Properly used alcohol must therefore be classed as a waste preventer.

100 cubic cent., $3\frac{1}{2}$ oz., of alcohol per diem (the quantity contained in about a litre of Rhine wine of medium strength) will supply from one third to one quarter of the whole amount of heat required by the human body in twenty-four hours.

Somewhat larger doses, still not large enough to intoxicate, produce the same effect in a more marked degree. But in addition the temperature is lowered owing to the dilatation of the blood-vessels of the skin, and consequent loss of heat by radiation; at the same time the activity of the heat-producing processes of the body appears to be diminished. The amount of urea and carbonic acid excreted is also lessened.

These effects, however, tend to diminish and disappear with use. The exhilaration at first produced by alcohol passes off and gives place to depression and lassitude, and when the habit has been acquired of drinking alcohol "for drinking's sake," there is no doubt that this depression is a powerful factor in causing the subject of it to continually increase the dose, and the evil effects of continually "nipping," as it is called in vulgar parlance, become apparent. The dilatation of the superficial blood-vessels becomes gradually chronic, and a bloated, blotched skin, with more or less bloodshot eyes and inflamed conjunctivæ, mark the confirmed drunkard. This dilatation of the blood-vessels in the alimentary tract produces permanent loss of tone and function, impaired appetite, and failure of the digestive powers, which, together with the excessive strain on the liver and kidneys, tend to promote the gradual break down of the organism. In these cases a severe attack of Bright's disease or of pneumonia, to which drunkards are often peculiarly liable, may, if the patient survive the struggle, be the means of breaking the habit. The enforced abstinence and rest during the illness and convalescence, if the patient have been originally strong and healthy, may enable his organs to return to their normal state, and as it were give him a fresh start. Cases of this kind are by no means uncommon.

Large doses of alcohol at frequent intervals produce different effects according as they are led up to by habit or not.

If only the usual progress in quantity made by an habitual drunkard, there may be no very apparent evidence of the effect, until the patient reaches a state from which he is at least unlikely to recover. The functions of all the organs become disorganised, cirrhosis of the liver, kidneys, and meninges of the brain, and accumulations of fat in all parts of the body, especially in the liver, heart, and connective tissues, take place. The capacity for resisting disease is reduced to a minimum, and an ordinary cold may put an end to the drunkard's career, or he may continue in his course until overtaken by general paralysis. A sudden and large increase of the dose in an habitual drunkard, or the administration of comparatively small quantities to persons quite unused to alcohol, or to children, or the sudden and complete withdrawal of alcohol from a person habituated to its use, will often set up acute cerebral disturbance and produce the violent and excited state known as *delirium tremens*. See Delirium Tremens.

Very large doses of alcohol, *e.g.* half or the whole of a bottle of spirits taken at once, will cause death in a few minutes; in these cases death is probably the result of shock from the violent irritation of the stomach set up by the spirit. See Drunkenness.

The question, Is alcohol a food? must on purely physiological grounds be answered in the affirmative, for we have seen that taken in certain small quantities it diminishes the consumption of fat in the body by taking its place, and with insufficient food a little alcohol may be useful; but in health, and with sufficient food, it is unnecessary for dietetic reasons. Small doses excite, large doses paralyse, the nervous system; it diminishes the sensation of hunger.

The undoubted value of alcohol in cases of temporary insufficiency of food will serve to some extent to account for drunkenness among the very poor, and if we add the temporary exhilaration and relief from present sorrow which it affords, it is not difficult to understand why the half-starved, the miserable, and unfortunate should fly to alcohol, that, for a time at least, they may forget their cravings and their sorrows. It is *easier*, perhaps, to give a glass of beer, but in nine cases out of ten a meal of good simple food would be *truer* charity. Those who lead active and laborious lives in the open air may take considerable quantities of wholesome alcoholic beverages with impunity; the conditions of their occupation enable them to throw it off with ease. But those who live in cities and lead sedentary lives should be abstemious to the last degree. The man who is honestly fatigued by hard manual labour can still eat a good meal and enjoy it; but it is quite different with the sedentary individual. His work does not stimulate his appetite, and he is but too apt when jaded and worried to find that he cannot eat his food, and to seek relief in alcohol from the indefinable weariness of mind and

body which oppresses him, and in this sense a vigorous appetite is a powerful preservative against drunkenness.

Effects due to Impurities and Adulterations. The use and value of alcoholic beverages may be a fair matter for discussion, but as to the evil effects of bad and impure alcohol, especially crude spirits, there is no doubt whatsoever, it is little better than poison; and it may be well here to point out, with regard to certain alcoholic drinks, the falsifications and defects of preparations which render them specially hurtful.

Beer. There is a notion in the public mind that beers are often adulterated with Indian hemp, grains of paradise, opium, and tobacco, in order to increase their intoxicating effects. That cases of such adulteration have been known cannot be denied, but that the practice is general, or indeed ever was, is absurd, for the simple reason that the adulterants are more costly than the proper articles, and the risk of poisoning and detection and their consequences are too serious to be encountered by even a very dishonest retailer. Water, sugar, and salt are the only adulterants worth considering, and assuming that we are dealing with persons who use beer in strict moderation, the worst results of these additions would be dyspepsia and perhaps increased thirst. New beer is very liable to disagree, and very strong old ale has a stupefying and intoxicating effect over and above the mere alcohol it contains. Good, honest beer, properly brewed and properly used, should not disagree with ordinary persons; gouty and rheumatic individuals should never touch it. The demand for a good light beer in England of late years has led to the introduction of 'lager' and its manufacture in this country. The price is unfortunately rather high, and prevents its general use. Large quantities are consumed in the United States, and it has made its way into India, where it is taking the place of brandy pawnee and whisky and soda water as a beverage.

Wine. Those who cannot afford *good* wine should learn to do without it. Port and sherry, at prices per bottle barely sufficient to pay carriage from the producing countries, cannot be genuine, and common sense should prevent their consumption. Many of the effects on which teetotalers delight to dwell are put down to port and sherry which never saw Oporto, or Xeres or even Spain, and are in reality a mixture of bad spirits with deleterious astringent colouring matters—made to sell.

Clarets and the Italian and Australian wines are not much adulterated, if at all, for the simple reason that it is not profitable to do so. The Australian wines are especially free from this imputation. Sherries, even when good, affect some persons unpleasantly, producing heart-burn and palpitation, probably on account of the potash salts they contain.

Spirits. Very much the same argument applies to spirits as to wine; really good, wholesome spirit is not cheap, and "little and good" should be the motto of those who make use of it.

Recently distilled spirit, even if made from the best material and in the best way, always contains other alcohols than ethylic, and these higher alcohols, especially amylic, are little else than poison, and it can be easily demonstrated on animals that it is to these bodies that the poisonous and maddening effects of alcohol are specially due. Long keeping in proper casks will do much to rid spirits of these deleterious principles, but the public are apt to forget that an article which has to be kept ten years before it is sold cannot be cheap. The demand for cheap spirit creates the supply, and the result is that much new spirits, and worse still, large quantities of potato spirit, which is especially contaminated with these higher alcohols (fusel oil), finds its way into the market, with disastrous effect to the consumer.

The Use of Alcohol in Disease requires great care and discrimination, and the custom of administering wine or spirits in households for any and every ailment is to be deprecated. As has been already said, alcohol in sufficiently large doses reduces the body temperature, at the same time exciting the cerebral and circulatory systems to greater activity. In certain diseases, where there is high fever with delirium, alcohol, given in comparatively large quantity, will sometimes reduce the temperature and relieve the cerebral symptoms when other drugs have failed, and as fever patients can tolerate large quantities of alcohol without exhibiting signs of intoxication it is allowable and sometimes even necessary to raise the dose beyond the limits ordinarily prescribed. As it is not usual to prescribe absolute alcohol, the following table, giving approximately the amount of absolute alcohol in some of the alcoholic drinks in most common use, will be of service:

Absolute Alcohol contained in

	Volumes per cent.
Koumiss . . .	from 1 to 3
Lager beer . . .	„ 3 „ 5
Hocks and clarets . .	„ 8 „ 11
Champagne . . .	„ 10 „ 13
Port, sherry, and madeira, &c.	„ 14 „ 17
Brandy and the stronger liqueurs	„ 30 to 50

As an antipyretic an adult will require 50 cubic centimetres—about 2 fluid oz.—of absolute alcohol daily in divided doses within an hour or two, *i. e.* according to the above table, about 20 oz. of champagne or 6 oz. of brandy. The carbonic acid in sparkling wines appears to be useful and to help in the reduction of the temperature.

The Temperance Question. That the *abuse* of alcohol is the cause of an immense amount of misery, disease, and crime admits of no doubt, and it is not, therefore, to be wondered at that well-intentioned people should denounce its use on any terms soever, and refuse to recognise its value under any circumstances. Such persons are not open to argument, nor do they realise apparently the very degraded view of human nature which their principles involve. There is generally some good, even in the most fanatical movement, and the advocates of temperance and total abstinence must be allowed to have done much towards the diminution of drunkenness and its consequences in this country. It is no longer the fashion to drink to excess, as it was in the early years of the present century, and drunkenness in this sense has descended very low in the social scale. Still, there is a vast amount of it, and what there is, is perhaps more of the nature of an active vice than mere stupid indulgence. Some of the possible

causes of this, viz. insufficient food and overwork and worry, have already been noted, and the direction in which the remedy is to be sought hardly requires pointing out. In the latter case education and experience can alone avail to prevent the abuse of alcohol.

The following quotation from an essay by Dr Lauder Brunton, F.R.S., puts the matter very clearly:

"There are some persons on whom the smallest quantity of alcohol seems to act like the taste of blood on a tiger, producing in them a wild desire for more, and destroying all self-control. For them alcohol is a poison, and total abstinence their only safeguard. There are others, again, who can do more mental work, and perhaps work of a better quality, by means of alcohol, than they could do without it, and who, when under its influence, are more sprightly, witty, and agreeable than at other times. Such persons may sometimes go on taking alcohol in moderation for a long time without doing themselves much harm, but they run a great risk. For the very increase in power which the alcohol gives them is apt to induce them to use it more and more, and when their nervous system begins to fail under the combined effect of the excessive demands upon it which alcohol enables them to make, and the distinctive action of excessive drinking itself, their self-control disappears, and they may sink into a drunkard's grave. Were it not for this risk the use of alcohol might be regarded as advantageous in those who are called upon to work only in "spurts," or to appear as pleasant companions or brilliant talkers only for a short time each day, and who are able to take abundant rest during the intervals, so as to allow time to repair the waste caused by the inordinate strain upon their powers during their periods of activity. But the number of men in this position is comparatively small, and most people are called on to do steady work day after day, and to make themselves at all times at least fairly agreeable to those whom they meet.

"For all such, alcohol is of little use so long as they are young and strong. They may possibly take it as a luxury, but if they eat well and sleep well they will as a rule do more work, mental or bodily, and be better without it. It is in those who are past middle life, and whose strength is declining with advancing years, in those who are debilitated by unfavourable external circumstances, or in those who are prostrated by disease, that alcohol most clearly exerts a beneficial action, and when properly used it becomes as powerful for good as it is for evil when abused.

"Alcohol may thus be very useful by imparting a power to accomplish a feat otherwise impossible, just as a bill may enable a merchant to tide over a crisis and complete a transaction which he could not have done with his current capital. So long as the merchant does not extend his liabilities too far, and the man does not make too great demands upon the reserve power of the organism, the one may employ bills and the other alcohol to accomplish his purpose, without injuring his credit or his health; but they run great risk whenever they exceed in the least, and great excess will lead to certain ruin. Lavish expenditure of money or strength must be followed by retrenchment, and the increased exertions made under the action of alcohol must be compensated by rest and food afterwards, unless the body is to break down completely. But just as the merchant, by the proper use of bills, may not only enlarge the sphere of his transactions, but add with certainty to his capital, so a proper use of alcohol may not only stimulate a man to increased exertion for a time, but help him to prevent any after depression by the use of food.

"This was well shown by the experience gained in the Ashantee campaign. When the men, marching under a burning sun, began to flag, a ration of rum served out to them temporarily removed their fatigue, and enabled them to proceed briskly. If the increased exertion required of them had lasted only a short time, the rum would have enabled them to bear it with ease; but as it usually extended over some hours the effect of the rum passed off and was succeeded by lassitude. Indeed it was generally found that after marching for three miles, the effect of the rum had completely disappeared, and was succeeded by a greater languor than before. If a second ration were now served out its stimulating effect was less, its action more transient, and the succeeding weakness still greater. When beef-tea was served out instead of rum, it appeared to stimulate quite as well, and was not succeeded by any reaction. It was at the end of the march that the beneficial action of the rum was most clearly seen. After long exertion the nerves of the stomach appear to participate in the general fatigue, and food then taken is not readily digested. If a small quantity of alcohol be taken first, it stimulates the stomach and quickens the circulation generally, thus enabling the food to be digested and absorbed so quickly that, before the effect of the alcohol has passed off, the products of digestion are already circulating in the blood and keeping up the strength of the individual. In young men a short interval of rest between fatiguing exertion and a succeeding meal will enable the stomach to regain its power, and alcohol is then unnecessary; but in men above middle age, where the reparative processes are slower, the use of alcohol is desirable. In Ashantee the elder men, over forty years of age, were not only glad of their own rations, but would take in addition those of their younger comrades who did not care for the spirit themselves." See INTEMPERANCE, STATISTICS OF.

ALCOHOLATE. *Syn.* ETHYLATE. A compound in which the 'typical' hydrogen of alcohol is replaced by a metal, *e.g.* Sodium Alcoholate or Ethylate, C_2H_5ONa; Calcium Ethylate, $(C_2H_5O)_2Ca$, &c. They are decomposed by water with reproduction of the alcohol, thus:

$$C_2H_5OK + HOH = C_2H_5OH + KOH$$

ALCOHOLIC. *Syn.* ALCOHOLICUS, L.; ALCOHOLIQUE, &c., Fr.; ALKOHOLISCH, Ger. Pertaining to, containing, of the nature of, or made with, alcohol.

ALCOHOLICA. [L.] *Syn.* ALCOÖLIQUES, Fr.; WEINGEIST-VERBINDUNGEN, Ger. In *pharmacy*, liquids containing, or preparations made with, alcohol, as a characteristic ingredient.

ALCOHOLISATION. [Eng., Fr.] *Syn.* ALCOHOLISATIO, L.; ALCOÖLISATION, &c., Fr.; ALKOHOLISERUNG, Ger. In *chem.* and *pharm.*, the development of the characteristic properties of alcohol in a liquid, or the use of it either as an

addition or a menstruum; also the act or process of obtaining alcohol from spirit by rectification.

ALCOHOLS. (*a*) In *chemistry*, the term 'alcohol,' originally limited to spirit of wine, is now applied to a large number of compounds, many of which show but little resemblance to common alcohol in external characters. Alcohols are compounds of neutral reaction, containing carbon, hydrogen, and oxygen. They are derived from hydrocarbons by the replacement of hydrogen by hydroxyl (OH), and are either saturated or unsaturated, according as the original hydrocarbons are. They react with acids to form ethers (compound ethers) and water, a reaction exactly analogous to that between bases and acids, thus:

$$\underset{\text{Potass. hydroxide (base).}}{K.OH} + \underset{\text{Acetic acid (acid).}}{C_2H_3O.OH} = \underset{\text{Potass. Acetate (salt).}}{C_2HO.OK} + \underset{\text{Water.}}{H_2O}$$

$$\underset{\text{Ethyl alcohol (alcohol).}}{C_2H_5.OH} + \underset{\text{Acetic acid (acid).}}{C_2H_3O.OH} = \underset{\text{Ethylic acetate (ether).}}{C_2H_3O.OC_2H_5} + \underset{\text{Water.}}{H_2O}$$

Further, just as we have mono-, di-, and poly-acid bases, so there are monatomic, diatomic, and polyatomic alcohols, according to the number of hydroxyl groups they contain in the molecule. Thus, methyl alcohol, CH_3OH, and ethyl alcohol, $C_2H_5.OH$, are monatomic; ethylene alcohol, $C_2H_4(OH)_2$, is diatomic; and glycerine (propenyl alcohol), $C_3H_5(OH)_3$, is triatomic. Oxidising agents convert the alcohols at first either into aldehydes or ketones, and finally into acids; *e.g.* ethyl alcohol, C_2H_6O, goes first into acetic aldehyde, C_2H_4O, and then into acetic acid, $C_2H_4O_2$.

(*b*) In *commerce*, pure spirits of a greater strength than about 58 o. p. (sp. gr. 0·8335), *i. e.* containing more than about 85% by weight, or 90% by volume, of pure alcohol, C_2H_6O.

(*c*) In *perfumery*, rectified spirit of wine, or commercial alcohol, holding essential oils or other odorous substances in solution.

(*d*) In *Fr. pharmacy*, alcoholic tinctures and essences.

ALCOOLATIFS (alcoölatifs). [Fr.] *Syn.* Alcoholati′va, L. In *Fr. pharmacy*, alcoholic solutions of liniments, embrocations, &c., whether made by distillation, maceration, or solution.

ALCOOLATS (alcoölats). [Fr.] In *Fr. pharmacy*, spirits; applied by Béral, Henry and Guibourt, and others, to medicated distilled spirits.

ALCOOLATURES (alcoölatures). [Fr.] *Syn.* Alcoholatu″ra, L. In *Fr. pharmacy*, alcoholic tinctures, elixirs, &c. M. Béral confines the term to vegetable juices preserved by alcohol.

ALCOOLES (alcoöles). [Fr.] Tinctures; the 'teintures alcoholiques' of the Fr. Codex.

ALCOOLIQUES (alcoöliques). [Fr.] *Syn.* Alcohol′ica, L. In *Fr. pharmacy*, alcoholic or spirituous solutions. (Béral.)

AL′DECAY. The galls on the leaves of *Myrobalanus chebula* (Gaertn.), a forest-tree of Bengal. Equal to the best oak-galls.

ALDEHYDE, acetic aldehyde, C_2H_4O, $= CH_3-CHO$ (name derived from 'alcohol dehydrogenatum'). B. Pt. 21° C (70° F.); sp. gr. 0·80. This compound is the most commonly known member of the class of '*aldehydes*,' compounds which are derived from the primary alcohols by oxidation, and which stand midway in composition between the alcohols and the acids, thus: Ethyl alcohol $= CH_3-CH_2OH$; aldehyde $= CH_3-CHO$; acetic acid $= CH_3{\cdot}COOH$. Further oxidation converts the aldehydes into the corresponding acids. As a class they are very active chemically. Being readily oxidised, they are powerful reducing agents, and they form characteristic crystalline compounds with ammonia, *e. g.* aldehyde-ammonia, $CH_3-CH(OH)NH_2$, and with the acid sulphites of the alkali metals, *e. g.* with sodium bisulphite the compound: $C_2H_4O + NaHSO_3 + \frac{1}{2}H_2O$. Many of the essential oils consist of aldehydes; thus, oil of bitter almonds is benzoic aldehyde, and the chief constituent of oil of cinnamon is cinnamic aldehyde. Acetic aldehyde is obtained in large quantity as a bye-product in the first portions of the distillate in the rectification of spirits.

Preparation. (*a*) 3 parts alcohol of 0·842 sp. gr. and 3 parts potassium bichromate are placed in a retort, and 4 parts of concentrated sulphuric acid are slowly run in. The heat evolved causes the aldehyde to distil over (*W. and R. Rodgers*, J. pr. Ch. **40**, 240). (*b*) Of the pure compound. Ammonia gas is passed into an ethereal solution of crude aldehyde, which has previously been dried over calcium chloride, and the precipitated aldehyde-ammonia is washed with ether, and then distilled with dilute sulphuric acid. The distillate is finally dried over chloride of calcium and rectified.

Properties. Aldehyde is a colourless mobile liquid of a peculiar aromatic and suffocating odour, its vapour—when inhaled in quantity—producing anæsthesia. It is miscible with water, alcohol, and ether in all proportions, and it dissolves sulphur, phosphorus, and iodine. Nascent hydrogen reduces it to alcohol, and it is slowly oxidised in the air (rapidly in presence of platinum black) to acetic acid. It polymerizes readily to para-aldehyde, $C_6H_{12}O_3$, and meta-aldehyde $(C_2H_4O)x$, and it ought, therefore, to be kept in a well-stoppered bottle in a cool place.

Reactions and Tests for. (1) It reduces an ammoniacal solution of silver nitrate, yielding a mirror of metallic silver. (2) When it is warmed with aqueous caustic potash, a brown substance, the so-called 'aldehyde resin,' is formed. (3) For its reactions with ammonia and with acid sulphites of the alkali metals, see *above*.

AL′DER (awl′-). *Syn.* Al′der-tree; Al′nus (ăl-), L.; *A. glutino′sa*, Gaertn.; *Betu′la alnus*, Linn.; Aune, Aulne, Fr.; Erle, Ger. A well-known English tree, chiefly growing in moist grounds near rivers. Its wood is used for hurdles, for various articles of turnery and furniture, and when converted into charcoal, for making gunpowder; it possesses considerable durability under water. The piles of the Rialto Bridge at Venice are of alder, and also those of many buildings in Amsterdam; but is otherwise of little value. Bark and leaves very astringent, and reputed vulnerary; decoction used as a gargle in sore-throat, and, in double the dose of cinchona, as a febrifuge in agues; bark and sap used in dyeing and tanning. The following belong to different nat. orders and genera to the preceding:

Alder, Black. *Syn.* Win′ter-berry; *Pri′nos verticilla′tus*, Linn. A tree growing in the United States of America. Bark febrifuge,

tonic, and astringent; berries tonic and emetic. (*Bigelow.*) It has been much recommended in dropsies, diarrhœa, intermittents, &c.—*Dose* (of the dried bark), ½ to 1 dr., 3 or 4 times a day.

Alder-tree, Black. *Syn.* BERRY-BEARING ALDER-TREE; *Rham'nus fran'gula*, Linn. A large shrub found in the woods and thickets of England, &c. Wood, BLACK DOG'WOOD; bark, bitter, emetic, purgative; used to dye yellow; root-bark, a drastic purgative; berries, purgative, emetic; unripe berries yield SAP-GREEN; charcoal of the wood esteemed the best for gunpowder. The dried bark is official in the B.P. When fresh it acts as an irritant poison, dried its action is less violent. Used as a purgative in constipation.—*Dose.* Extract, 15 to 60 gr., liquid extract, 1 to 4 dr.

ALE. Formerly malt liquor brewed without the use of hops, and drunk previous to their introduction by the Germans. Now included under the term BEER, which *see*.

Ale, Devonshire White. A liquor once drunk generally, and still in demand in some parts of Devonshire.

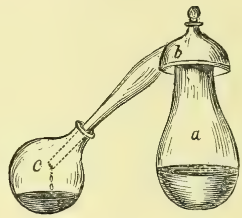
Prep. Ordinary ale-wort (preferably pale) sufficient to produce one barrel, is slowly boiled with about three handfuls of hops and 12 to 14 lbs. of crushed groats, until the whole of the soluble matter of the latter is extracted. The resulting liquor after being run through a coarse strainer, and cooled to about 60° F., is fermented with 2 or 3 pints of yeast; and, as soon as the fermentation is at its height, is either closely bunged up for 'draught,' or is at once put into strong stoneware bottles which are then well corked and wired.

ALES, MED'ICATED. *Syn.* BRYT'OLES; BRUTOLÉS, Fr.; CEREVIS'IÆ MEDICA'TÆ, L. In *pharmacy*, ale prepared by macerating medicinal substances in it, either at the ordinary temperature of the atmosphere, or when heated; infusions and decoctions, in which ale or beer is employed as the menstruum. The old dispensatories enumerate several medicated ales; such as CEREVISIA OXYDOR'CICA, for the eyes; C. ANTIARTHRIT'ICA, for the gout; C. CEPHAL'ICA, for the head; C. EPILEP'TICA, against epilepsy, &c. Preparations of this kind are now seldom ordered by the Faculty, and their use is chiefly confined to the practice of empirics, and to domestic medicine. Bark, rue, savine, antiscorbutic plants, aromatic bitters, and stomachics, are the substances most commonly administered in this way. Ale in which wormwood, gentian, orange-peel, and the like, have been steeped, taken warm early in the morning, is much esteemed as a restorative tonic by drunkards and dyspeptics. See BEER, PURL, &c.

ALE'BERRY. A beverage made by boiling ale with spice, sugar, and bread-sops; the last commonly toasted. A domestic remedy for a cold.

ALE'GILL (*g* hard). Ale or beer flavoured or medicated by infusing the leaves of ground ivy in it; pectoral, stomachic, and nervine.

ALEM'BIC. *Syn.* MOORS'HEAD†, ALEM'BICUS, L.; ALAMBIC, Fr.; DESTILLIRKOLBEN, Ger. An old form of distilling vessel, usually made of glass or earthenware, but sometimes of metal. The body (*a*) which holds the liquid for distillation is called the CU'CURBIT; the upper part (*b*) the HEAD or CAP'ITOL: while (*c*) is the RECEIVER. It is now very rarely if ever used in the laboratory, although it has certain advantages over an ordinary retort; thus, any residue left after distillation is readily cleared out, and, when a



distillate consists of a mixture of solid and liquid, the solid collects for the most part in the head, while the liquid passes over into the receiver.

ALEMBROTH SALT. SAL ALEMBROTH. *Syn.* AMMONIO-MERCURIC CHLORIDE. DOUBLE CHLORIDE OF MERCURY AND AMMONIUM. $(NH_4Cl)_2HgCl_2 + H_2O$. Its name is said to be of Chaldee origin, and to signify the key of art. It is made by mixing 271 parts of mercuric chloride and 107 parts of ammonium chloride, both dissolved in water, and evaporating the solution, allowing crystals to form. The crystals are flattened prisms very soluble in water.

Uses. Powerful antiseptic, often used as a surgical dressing in the form of alembroth gauze and alembroth wool. The former contains 1%, the latter 2% of the salt tinted blue.

ALEPPO EVIL. See DELHI BOIL.

ALEURITES MOLUCCANA. See CANDLE-NUT.

ALEUROM'ETER. *Syn.* ALEUROMÈTRE, Fr. An instrument for determining the quantity and quality of gluten in wheat-flour, invented by M. Boland. It essentially consists of a hollow copper cylinder, about 6 inches long, and ¾ of an inch internal diameter. This tube has two principal parts; the one, about two inches long, is closed at the lower end, forming a kind of cup, in which the gluten is placed; it screws into the remainder of the cylinder. The cup being charged with a sample of gluten, and the upper part of the cylinder being screwed on, it is exposed in an oven, or (preferably) in an oil bath, to a temperature of 350°—380° Fahr. From the length of the tube the gluten occupies in swelling, as measured by a graduated scale, its quality is determined. The 'crude gluten' of good wheat-flour augments to four or five times its original volume, when thus treated; but that from bad flour does not swell, becomes viscid and semi-fluid, and generally gives off a disagreeable odour; whilst that of good flour merely suggests the smell of hot and highly-baked bread. Mr Mitchell recommends the heat to be 420°, whilst Dr Muspratt gives 284° Fahr. as the proper temperature; but of these the first is too high, and the other too low. About 210 gr. are also ordered to be taken for examination; but the exact quantity is immaterial. (See Mitchell's 'Falsification of Food.')

ALEURONE GRAINS. In oily seeds the proto plasm is aggregated into spherical granules of various sizes, which lie in a matrix of albuminous

and fatty matter; these are the proteid or aleurone grains. The granules consist of albuminous substances, but almost always enclose other bodies of a crystalline form, though proteid in nature; also other peculiar small round bodies (*globoids*), consisting of double phosphate of lime and magnesia. (*Vines* and *Prantl.*)

ALE'WIFE. The *Clupea serrata*, an American species of herring. Its proper name is a'loof, although the established pronunciation and common orthography is ale-wife.

AL'GA. (-gă.) [L.] Seaweed. A common name of grass-wrack (*Zostera marina*—Linn.), though not one of the algæ.

AL'GÆ. (ăl'-jē.) [L. pl.] *Syn.* AL'GALS; ALGÆ (DC.), AL'GALES (*Lindl.*), L.; ALGUES, VARECH, Fr.; ALGE, MEERGRASS, SEEGRASS, Ger. Sea-weeds. In *botany*, an order of Thallogens living in water or very moist places, nourished throughout their whole surface by the medium in which they live, having no distinct axis of vegetation. Linnæus defines them—"plants, the roots, leaves, and stems of which are all in one." The apparent roots are only for attachment, and are not to be compared with the roots of plants. Algæ consist either of simple vesicles lying in mucus, or of articulated filaments, or of lobed fronds formed of uniform cellular tissue. Those that vegetate in salt water are popularly called SEAWEEDS (fu'ci, L.) and LA'VER (ulvæ, L.); those found in fresh water CONFER'VÆ. One of their divisions (the *Zoöspermeæ*) comprehends the lowest known forms of vegetable life, being merely adhering cells, emitting, at maturity, seeds or sporules having a distinct animal motion. In *Oscillatorias*, the whole plant twists and writhes spontaneously; and *Zymenas* actually copulate like animals. Some of the algæ possess great beauty. In the lower grades the colour is green; in the higher, red or purple. The algæ are propagated by simple division and by spores contained in special organs, archegonia, which are fertilised by antherozooids developed in other organs called antheridia. Some of these spores have cilia, and are motile (zoospores).

Prop., Uses, &c. None of the algæ are poisonous. Several are nutritious, emollient, and demulcent, from containing mucilage (carrageenin), starch, sugar (mannite), and a little albumen; and are hence used as esculents. The ash from the dried weed varies in different varieties from 9% to fully 25%; and contains variable quantities of potassa, soda, lime, magnesia, iron, manganese, and silica, with sulphuric acid, phosphoric acid, chlorine, and a little iodine and bromine. (*Schweitzer; Forchammer; Gödechens.*) Seaweeds, their charcoal, and their ashes have been long regarded as alterative and resolvent; and antiphthisic virtues have been attributed to them by Laennec and others. They were formerly much given in scrofulous affections and glandular enlargements; but their use is now almost superseded by that of iodine and its preparations. Dr Stenhouse has proposed to use some of the algæ as an economical source of mannite. The sea algæ are used for manure; their ashes form KELP.

The following table, showing the results of several analyses of different kinds of algæ, is given by Mr Wynter Blyth in his dictionary of 'Hygiene and Public Health.'

Kinds of Algæ.	Water.	Dry matter.	Per cent. Nitrogen in dry matter.	Protein contained in dry matter.
Chondrus crispus, bleached, from Bewlay Evans	17·92	82·08	1·534	9·587
Chondrus crispus, unbleached, Ballycastle	21·47	78·53	2·142	13·387
Gigastina mamillosa, Ballycastle	21·55	78·45	2·198	13·737
Chondrus crispus, bleached, second experiment	19·79	80·21	1·485	9·281
Chondrus crispus, unbleached, second experiment	19·96	80·04	2·510	15·687
Laminaria digitata, or dulse tangle	21·38	78·62	1·588	9·925
Rhodomenia palmata	16·56	83·84	3·465	21·656
Porphyra laciniata	17·41	82·59	4·650	29·062
Iridœa edulis	19·61	80·39	3·088	19·300
Alaria esculenta	17·91	80·09	2·424	15·150

For reasons which will be stated under GELATINE and FOOD the large proportion of nitrogen contained in algæ is *not* to be regarded *in any sense* as a measure of their nutritive qualities. The following are the chief varieties of algæ which are used as food by the dwellers on our coasts as well as on the Continent:—PORPHYRA LACINIATA and VULGARIS, called *laver* in England, *stoke* in Ireland, and *slouk* in Scotland. CHONDRUS CRISPUS, called *carrageen* or *Irish moss*, and also *pearl-moss* and *sea-moss*. LAMINARIA DIGITATA, known as the *sea-girdle* in England, *tangle* in Scotland, and *red-ware* in the Orkneys; and LAMINARIA SACCHARINA, ALARIA ESCULENTA, or *bladder-lock*, called also *hen-ware*, and *honey-ware* by the Scotch. ULVA LATISSIMA or GREEN LAVER—RHODOMENIA PALMATA or *dulse* of Scotland. Under the name of 'marine sauce' the LAVER was esteemed a luxury in London, where it may now occasionally be met with in the shops of provision merchants. CHONDRUS CRISPUS or *carrageen* is sometimes employed as an aliment for consumptive and weakly persons. In preparing the algæ for food they must be soaked in water to remove the saline matter, and where they are possessed of a bitter flavour this may be removed by adding a little carbonate of soda to the water. They should then be stewed in water or milk till they are tender. The best flavourings are pepper and vinegar. See JELLY.

ALGARO'BA. *Syn.* CA''ROB-TREE, ST JOHN'S BREAD; *Cerato'nia sil'iqua*, Linn. A legumin-

ous tree of southern Europe, Palestine, and part of Africa. Pods (ALGAROBA BEANS), used for food, and to improve the voice; they contain a sweetish, nutritious powder, and are supposed to have been the 'locusts' on which St John fed in the wilderness; their decoction has been used as a pectoral in asthma and coughs.

ALGAROBILLA. Is the fruit of the *Balsamocarpum brevifolium*, a tree growing in Chili. The pericarp contains 40% to 50% tannin, and resembles the fruits of divi, bablah, and neb-neb, used in tanning. As the tannin exists in the algarobilla in the free state, it readily dissolves in water. In practice the solution alone does not give a serviceable leather; it must be used with other tanning substances.

ALGIN. A name given by Mr E. C. C. Stanford to a gelatinous substance prepared by him from algæ—by extraction with cold water containing a little sodic carbonate; in twenty-four hours the whole plant disintegrates, and forms a thick gelatinous mass, containing about 2% of total solid matter. By gently heating and diluting it can be filtered with difficulty, and the cellulose separated. The filtrate is then treated with sulphuric or hydrochloric acid, when the alginic acid separates out in flocculi, which may be washed, dried, and pressed into cakes. When required for use these cakes are dissolved in carbonate of sodium solution in the cold, and form in 5% solution a jelly too thick to pour; spread in films over a large surface it may be dried and preserved indefinitely for use. The solution does not coagulate on heating, and is precipitated by alcohol, most acids, and nearly all metallic salts. Analysis of a dialysed specimen gave carbon 44·39, hydrogen 5·47, nitrogen 3·77, oxygen 46·37.

Mr Stanford is of opinion that algin should be of great service in the arts as a sizing and dressing for various fabrics, and as a cheap mordant, and mixed with powdered charcoal as a covering for steam tubes; it is said to prevent incrustation in steam boilers; for fining spirits and emulsifying oils; and as a jelly for the table.

ALGONTINE. A mouth and tooth wash. An aqueous solution of nitrate of potassium, aromatised with oil of peppermint, tincture of myrrh, and tincture of cinnamon.

AL'IMENT. [Eng., Fr.] *Syn.* ALIMEN'TUM L.; NAHRUNG, SPEISE, Ger. Food; nutriment; anything which nourishes or supports life.

ALIMENT'ARY. *Syn.* ALIMENTA''RIUS, L.; ALIMENTAIRE, Fr.; ZUR NAHRUNG GEHÖRIG, Ger. Pertaining to food or aliment; nutritive; nourishing.

Alimentary Canal'. *Syn.* ALIMENTARY TRACT; CANA'LIS ALIMENTA''RIUS, L. In *anatomy*, the cavity in the bodies of animals into which the food is taken for the purpose of being digested; the whole passage or conduit extending from the mouth to the anus. In some of the lower animals this is a simple cavity, with only one opening; when the same aperture which admits the food also gives egress to the excrementitious matter. In others it is a true canal with both a mouth and an outlet. Another step, and we find this canal is divided into a stomach and intestines. In the higher grades, a mouth, pharynx, and œsophagus precede the stomach. Birds have one or two sacculi or crops added to the œsophagus. The stomach of the ruminants consists of four sacs or parts, each of which may be regarded as a separate stomach; that of the bottle-nose whale contains no less than seven of such sacs. The part below the stomach, forming the intestines, is also variously subdivided, complicated, and connected. In man, these subdivisions are termed—DUODENUM, JEJU'NUM, IL'EUM, CÆ'CUM, CO'LON, and REC'TUM; the lower end or orifice of the last being called the A'NUS. The existence of an alimentary canal is said to be the only true characteristic of an animal. Plants have no common receptacle for their food, nor canal for carrying away effete matter; but every animal, however low in the scale of being, possesses an internal cavity which serves it as a stomach.

Alimentary Sub'stances. *Syn.* ALIMENTS; MATE''RIA ALIMENTA''RIA, L. Substances employed as food.

ALIMENTA'TION. [Eng., Fr.] *Syn.* ALIMENTA'TIO, L.; NAHRHAFTIGKEIT, Ger. The act, process, power, or state of nourishing, or being nourished.

AL'I-QUOT. An aliquot part of a number or quantity is one which will measure it without a remainder, *e. g.* 10 is an aliquot part of 50.

AL'IZARI. [Tur., ali-zari.] The commercial name of madder in the Levant.

ALIZARIN. $C_{14}H_6O_2(OH)_2$. This article includes short descriptions of the other anthracene colours: Anthrapurpurin, Flavopurpurin, Purpurin, Alizarin-carmine, Alizarin-orange, and Alizarin-blue.

(*a*) *Natural Alizarin.* This colour is one of the constituents of madder, the dried root of ***Rubia tinctorum***, Linn. It has been used from the earliest times, the red wrapping of the Egyptian mummies being dyed with this substance. Although the plant was cultivated in Italy at an early date, it was only introduced into Holland in the sixteenth and into France in the seventeenth century. This cultivation was formerly a very considerable industry, one department of France, Vaucluse, alone producing eighty millions of lbs. annually, representing a value of about a million sterling. But the production has of late years dwindled to very small proportions, owing to the manufacture of artificial alizarin from anthracene, the natural product being now only used for wool dyeing.

The root is the only part used for dyeing. In the Levant it is collected once in every five years, in France once in every three. The madder is never used when freshly gathered, but is always kept for from one to three years. During this period the colour is gradually developed. This change was first explained in 1851 by Schunck, who showed that madder root contained a ferment, erythrosin, $C_{56}H_{34}N_2O_{40} + 4CaO$, and a glucoside, rubian, $C_{28}H_{34}O_{15}$, and that under the influence of the former the rubian was decomposed, yielding madder red or alizarin, thus:

$$C_{28}H_{34}O_{15} = 2C_{14}H_{10}O_4 + 7H_2O.$$

Subsequent researches have shown that madder contains besides alizarin four other colouring matters, viz. madder-purple or purpurin, madder-orange or rubiacin, madder-yellow or xanthin, and madder-brown. Alizarin and purpurin are the two most important constituents of madder.

For practical purposes it is necessary only to consider madder as containing two colouring principles, viz. the dun or yellow which forms the impurity of the madder and has to be removed, and the red colouring matter. The yellow does not itself combine with the cloth, but it has a great affinity for the other colouring matters, and is precipitated with them, to be afterwards removed. The red colouring matter is composed of the above red and purple principles (alizarin and purpurin). It is not very soluble in water, hence to produce deep shades the goods must be put in the boiler with the madder.

Madder red, or alizarin, can be prepared by the following methods:

1. More or less pure alizarin can be obtained by mixing powdered madder with an equal weight of sulphuric acid, allowing the mass to rest for a few hours and then washing it well with water. This product forms the 'garancine' formerly so much used in dyeing.

2. The alcoholic extract of 'garancine,' dried and reduced to a fine powder, is laid upon a sheet of filtering paper, placed upon an iron shovel. The latter is then cautiously heated, when the extract melts, the paper absorbing a brown resinous matter, whilst the alizarin sublimes on the surface of the mass in the form of beautiful orange-coloured crystals. It has a dyeing power ninety-five times as great as that of madder.

3. Alizarin may also be separated from a mixture of madder and sulphuric acid by passing a current of steam through the mass. The alizarin volatilises with the steam and is deposited in flocks when the latter is condensed.

For properties see ARTIFICIAL ALIZARIN.

(*b*) *Artificial Alizarin.* M. Pt. 280° C. (536° F.); sublimes at 140°—150° C. (284°—302° F.) This colour was first obtained artificially by Graebe and Liebermann in 1869 from anthraquinone, an oxidation product of anthracene, the latter being one of the substances which result from the destructive distillation of coal-tar (see COAL-TAR DISTILLATION). In the original process the anthraquinone was converted into a dibromide, and the bromine of this then replaced by hydroxyl, by treatment with caustic soda, thus:

$$(a)\quad \underbrace{C_{14}H_8O_2}_{\text{Anthraquinone.}} + 2Br_2 = \underbrace{C_{14}H_6Br_2O_2}_{\text{Dibromo-anthraquinone.}} + 2HBr;$$

$$(b)\quad C_{14}H_6Br_2O_2 + 2NaOH = \underbrace{C_{14}H_6(OH)_2O_2}_{\text{Alizarin.}} + 2NaBr$$

At the present day the anthraquinone is converted into sulphonic acids, which, on treatment with caustic soda, give the various alizarins. Anthracene, which forms the starting-point, consists of two benzene rings (see BENZENE) united by the group C_2H_2:

$$C_6H_4\begin{matrix}\diagup CH \diagdown\\ \diagdown CH \diagup\end{matrix}C_6H_4.$$

On oxidising it with potassium bichromate and sulphuric acid, the hydrogen in the C_2H_2 group is replaced by oxygen, and anthraquinone results:

$$C_6H_4\begin{matrix}\diagup CO \diagdown\\ \diagdown CO \diagup\end{matrix}C_6H_4.$$

Anthraquinone, when heated with fuming sulphuric acid, gives one monosulphonic and two disulphonic acids (α and β) thus:

$$C_6H_4.C_2O_2.C_6H_4 + H_2SO_4 = \underbrace{C_6H_4.C_2O_2.C_6H_3.SO_3H}_{\text{Anthraquinone-monosulphonic acid.}} + H_2O$$

The next operation in the manufacture of the alizarins is the introduction of hydroxyl into the anthraquinone molecule, by fusing the sulphonic acid with caustic soda. This reaction does not consist simply in a replacement of the sulphonic group by hydroxyl, but is always accompanied by an oxidation, thus:

$$C_{14}H_7O_2.SO_3Na + 3NaHO = C_{14}H_6O_2(ONa)_2 + Na_2SO_3 + H_2 + H_2O.$$

The hydrogen is not evolved in the pure state, but acts as a reducing agent on the sulphonic acid and alizarin produced, thereby diminishing the yield. It is hence advantageous to mix a quantity of potassium chlorate with the melt, in order to oxidise the hydrogen.

If pure sulphonic acids be used, pure colours will result. In this way anthraquinone-monosulphonic acid yields alizarin by treatment with soda, the α-disulphonic acid, flavopurpurin, and the β-acid, anthrapurpurin. The various shades of commercial alizarin are due to the preponderance of one or other of these colours. When the above reaction is completed, the mass is allowed to cool, extracted with water, the solution acidulated, and the precipitated alizarin washed and ground into a paste with water.

The following (taken from Friedlander's 'Fortschritte der Theerfarben-fabrikation') gives the main details for the manufacture of alizarin as practised at the present day.

Anthracene (which *see*), containing 50% to 60% of the pure substance, is used. The first operation consists in bringing it into a fine state of division by subliming in a current of superheated steam. It is then boiled with a 5% to 10% solution of potassium bichromate, the calculated quantity of dilute sulphuric acid being gradually added. The quantity of bichromate must be so adjusted that the anthracene only is oxidised, the impurities, phenanthrene, carbazol, acridine, &c., remaining unaltered. This necessitates a previous determination of the percentage of pure anthracene in the sample, the best plan being to oxidise a weighed quantity of the latter, under conditions the same as those in the manufacture. See ANTHRACENE.

When the oxidation is complete, the crude anthraquinone is filtered off, washed, and dissolved in 2 to 3 parts of sulphuric acid (of 66° B., *i.e.* 1·815 sp. gr.), and heated to 110° C. (230° F.) with stirring, until a portion, on dilution with water, gives nearly white anthraquinone. The mass is then allowed to cool, when the greater portion of the anthraquinone crystallises out, the impurities remaining behind as sulphonic acids. The rest of the anthraquinone is precipitated on dilution with water. The anthraquinone, after washing with water and dilute soda, contains 90% to 95% of the pure substance. (Attempts to use other oxidising agents than chromic acid have failed. By precipitating the solution of chromium

sulphate with magnesia, and igniting the precipitate with lime in the presence of air, the greater part of the chromic acid can be regenerated).

To convert the anthraquinone into the monosulphonic acid (for alizarin), it is heated to 160° C. (320° F.), with an equal weight of fuming sulphuric acid containing 45% of the anhydride (SO_3), by which means 25% of the anthraquinone remains unaltered, 50% is converted into the monosulphonic acid, and 25% into the disulphonic acids.

The mass is diluted with water, filtered hot from unaltered anthraquinone, neutralised with soda and concentrated, when the sparingly soluble sodium salt of the monosulphonic acid separates out in silvery leaves. The more soluble disulphonic acids crystallise out after the sodium sulphate, when the mother-liquor is concentrated.

In order to convert the monosulphonic acid into alizarin, its sodium salt is heated to 160° to 170° C. (320° to 338° F.) with caustic soda, potassium chlorate, and a little water, in the proportions represented by the equation:

$$3C_{14}H_7O_2.SO_3Na + 9NaHO + 2KClO_3 = 3C_{14}H_6O_2(ONa)_2 + 3Na_2SO_4 + 2KCl + 6H_2O.$$

The heating lasts for 2½ to 3 days, and is carried out in cast-iron vessels, provided with a stirring arrangement. At the end of the reaction the mass is diluted with water, and the alizarin precipitated from the intensely violet-coloured liquid by addition of dilute hydrochloric or sulphuric acid. The bright brown amorphous flocks are well washed with water, and sent out in the form of a paste, containing generally 20% of alizarin. It cannot be dried, since it then loses its water of hydration and, as a consequence, its fine state of division, and is not so readily absorbed in dyeing.

Commercial alizarin is sold chiefly in two varieties: alizarin-blue shade, or alizarin V; and alizarin-yellow shade, or alizarin G (see DYEING for meaning of letters). The first consists mainly of pure alizarin as prepared by the foregoing directions. The second contains larger quantities of anthra- and flavo-purpurin.

Alizarin V gives, when dyed with alumina, a bluish, but not very brilliant, red. With a small amount of mordant, however, very fine pinks can be obtained. It is also used for violets with an iron mordant.

Alizarin G gives a neutral or yellow-red, according to the proportion of anthra- or flavopurpurin. The violets obtained with the two last colours are of no value.

Impurities. Alizarin is frequently contaminated with anthraquinone and isomeric oxyanthraquinones. These can be detected by boiling with lime and filtering. If the filtrate is brown, these impurities are present. They have no value in dyeing.

The separation of alizarin, flavopurpurin, and anthrapurpurin is difficult. The presence of the two latter may be detected as follows:—The substance is heated in an air-bath to 140° to 150° C. (284° to 302° F.), at which temperature the alizarin is volatilised. When it is completely removed, the residue is heated between watch-glasses to 170° C. (338° F.), and the sublimate obtained examined with the microscope; flavopurpurin is found in yellowish needles, anthrapurpurin in thick crystals.

The *valuation* of alizarin is effected by comparative dye-trials (see DYEING), and by the determination of dry substance at 100° C. (212° F.) [the sample must not be heated above 110° C. (230° F.), as pure alizarin begins to sublime at this temperature] and of ash. The residue on drying should be yellow, not brown. Alizarin paste is frequently thickened by glycerine and turkey-red oil. These can be detected by diluting with water and filtering. The filtrate may also contain salts derived from the manufacture; it should be colourless. The ash should not exceed 1% of the dry substance, and should be free from iron.

Pure alizarin can be obtained from alizarin V of commerce by dissolving in caustic soda, filtering, adding barium chloride in excess, and heating to boiling; crystalline barium alizarate then separates out. The precipitate is filtered off, washed, and decomposed with excess of hydrochloric acid, and the liberated alizarin well washed from barium chloride. A further purification can be effected by sublimation or by crystallising from glacial acetic acid.

For application of alizarin see DYEING.

OTHER ANTHRACENE COLOURS. These are anthrapurpurin, flavopurpurin, purpurin, alizarin-carmine, alizarin-orange, and alizarin-blue (XR and S).

Anthrapurpurin (sometimes called isopurpurin) and *flavopurpurin* have been already mentioned.

Purpurin, $C_{14}H_5O_2(OH)_3 + H_2O$. M. pt. 253° C. (487·4° F.); sublimes at 150° C. (302° F.) (see ALIZARIN). This colour does not occur in artificial alizarin, but is an important constituent of madder, a fact which must be borne in mind in comparing the results of dyeing with natural and artificial alizarins. Purpurin is a trioxy-anthraquinone, the hydroxyls being in the same benzene ring (position 1 : 2 : 4; see BENZENE).

It is prepared by dissolving alizarin in concentrated sulphuric acid and oxidising with dry arsenic acid (As_2O_5) at 150°—160° C. (302°—320° F.). The product is diluted with water, and the precipitate so produced washed with alum, which dissolves out the purpurin. It is precipitated from the alum solution by addition of hydrochloric acid, and recrystallised from alcohol. Obtained in this way it forms red crystals, which dissolve in boiling water with a dark red colour, in alkalies with a purple colour, and in alum with a yellowish-red colour and green fluorescence. The solution in alkalies is decolourised by light. A solution in alum, when acidulated with excess of acid, gives a purpurin hydrate, which is more soluble in alcohol than ordinary purpurin.

Purpurin is not used on a large scale, as the crude substance gives an inferior steam red. The pure substance gives a very brilliant scarlet.

Alizarin-carmine is a sulphonic acid of alizarin prepared by heating 1 part alizarin with 3 parts concentrated sulphuric acid (containing 20% anhydride) to 100°—150° C. (212°—302° F.). The product is dissolved in water, the excess of acid neutralised with lime, and the clear liquid evaporated. It forms three series of

salts. The monobasic salts are orange or yellow, the dibasic reddish-violet or reddish-yellow, and the tribasic salts intensely violet. Although this dye has a strongly acid reaction and is very soluble, it is not much used, as it lacks brilliancy when compared with cochineal, azo-scarlets, and eosins.

Alizarin-orange. This is β-nitro-alizarin ($OH : OH : NO_2 = 1 : 2 : 4$), and is prepared by treating alizarin in solution with nitrous fumes. The raw product is purified by solution in sodium carbonate and precipitation with acid. It forms yellow needles which melt at 244° C. (471·2° F.).

Alizarin-orange is more strongly acid than alizarin itself; it is almost insoluble in water, but dissolves in glacial acetic acid. The alkaline salts are soluble in water, but are precipitated in the presence of much free alkali. This fact can be made use of for the detection and separation of impurities in the commercial product. With alumina mordants nitro-alizarin gives an orange, with iron mordants a reddish-violet colour.

Alizarin-blue (X R) is a quinoline of alizarin (see QUINOLINE), and is prepared by heating nitro-alizarin with 5 parts concentrated glycerine and 5 parts sulphuric acid to 150° C. (302° F.). The mass is boiled with water and left to cool, when the sulphuric acid compound is deposited in brown flocks which become blue on washing, from loss of sulphuric acid. It occurs in commerce as a 10% paste. The pure substance melts at 270° C. (536° F.). It is insoluble in water, and but sparingly soluble in benzene and alcohol. It dissolves with a greenish-blue colour in alkalies, and is precipitated by excess of the latter. With lime, baryta, and ferric oxide it yields greenish-blue lakes, with alumina and chromic oxide, blue-violet lakes. Its alkaline solution is reduced by zinc dust to a red liquid, which takes up oxygen, and resumes its blue colour when exposed to the air. This property is of value, as it enables alizarin-blue to be used for vat dyeing, like indigo.

Alizarin-blue S. This is a compound of the above dye with an acid sulphite. It can be prepared by mixing the commercial paste with a concentrated solution of sodium bisulphite ($NaHSO_3$), allowing the mixture to stand for 8 to 14 days, filtering, and precipitating the compound by saturating the solution with common salt. It forms a purple powder readily soluble in water, and decomposed into its constituents by heating to 70° C. (158° F.). It can be mixed with mordants without undergoing any change until the solution is heated. The above properties render alizarin-blue S. very valuable for dyeing, and there is consequently a likelihood of its supplanting indigo to some extent.

ALKALI. *Syn.* ALKALI, Fr.; LAUGENSALZ, Ger. This term has been used at different times to denote a number of different substances, but is now usually restricted to the hydrates of the oxides of potassium, sodium, lithium, cæsium, rhubidium, and ammonium (a solution of ammonia, NH_3, in water may be looked upon as ammonium hydrate). The following properties are characteristic of them:—(1) They are readily soluble in water (lithia, however, much less so than the others), the aqueous solution changing the hue of many vegetable colouring matters, *e. g.* turning red litmus blue, and yellow turmeric brown (see ALKALIMETRY). (2) They neutralise acids, reacting with these to form salts. (3) Their solutions absorb carbonic acid from the air, forming carbonates. (4) They precipitate most of the heavy metals, as oxides or hydrates, from solutions of their salts. (5) They saponify the fixed oils and fats. (6) They exert a caustic or corrosive action on animal and vegetable substances.

ALKALI ACTS. The principal Alkali Act is the 26 and 27 Vict., c. 24, amended by 37 and 38 Vict., c. 43, the amended Act having come into operation in 1875.

Every alkali work must be carried on so as to ensure the condensation of not less than 95% of muriatic acid evolved therein; and it must be so condensed that in each cubic foot of air, smoke, or chimney gases, escaping from the works into the atmosphere, there is not contained more than one fifth part of a grain of muriatic acid. Penalty for first conviction, £50; for second and other offences, £100, or less (26 and 27 Vict., c. 124, s. 4; 37 and 38 Vict., c. 43, s. 4).

The owner of every alkali work is also bound "to use the best practicable means of preventing the discharge into the atmosphere of all other noxious gases arising from such work; or of rendering such gases harmless when discharged."

The noxious gases are defined to be sulphuric acid, sulphurous acid (except that arising from the combustion of coal), nitric acid, or other noxious oxides of nitrogen, sulphuretted hydrogen, and chlorine (37 and 38 Vict, c. 43, ss. 5 and 8).

The owner is liable for any offence against the Alkali Acts, unless he proves that the offence was committed by some agent, servant, or workman, and without his knowledge, in which case the agent, &c., is liable (26 and 27 Vict., c. 124, s. 5).

Every alkali work must be registered; penalty for neglect £5 per day (ibid., s. 6).

Powers are given to owners to make special rules for the guidance of their workmen (ibid., s. 13).

The Alkali, &c., Works Regulation Act, 1881, 44 and 45 Vict., ch. 37.

§ 3 Provides that of the acid gases of sulphur and nitrogen evolved in the process of manufacturing sulphuric acid or sulphates, each cubic foot of air, smoke, or gases escaping into the chimney or atmosphere shall not contain more than the equivalent of four grains of sulphuric anhydride.

§ 5. Acid drainage and alkali waste to be kept apart.

Power given to sanitary authority to construct and maintain special channel for acid waste, at the expense of the owner, and to conduct same into the sea or into a river so far as allowed by the Rivers Pollution Act of 1876.

Schedule of works under this Act:

(1) Sulphuric acid works, that is to say, any works in which the manufacture of sulphuric acid is carried on (not being alkali works within the meaning of the foregoing Act and not being works in which the manufacture of sulphuric acid is carried on in conjunction with the extraction of copper or other metals from ore);

(2) Chemical manure works, that is to say, works in which the manufacture of chemical manure is carried on.

(3) Gas liquor works, that is to say, any works in which gas liquor is used in any manufacturing process.

(4) Nitric acid works, that is to say, any works in which the manufacture of nitric acid is carried on.

(5) Sulphate of ammonia works and muriate of ammonia works, that is to say, any works in which the manufacture of sulphate of ammonia or muriate of ammonia is carried on; and

(6) Chlorine works or works in which chlorine, bleaching powder, or bleaching liquor is made. By § 30 the following Acts are repealed, most of their important clauses being embodied in the new Act. The Alkali Act, 1863 (26 and 27 Vict., c. 124). The Act to make perpetual the Alkali Act, 1863 (31 and 32 Vict., c. 36), and the Alkali Act, 1847 (37 and 38 Vict., c. 43). See NOXIOUS TRADES.

ALKALIM'ETRY. *Syn.* ALKALIME'TRIA, L.; ALCALIMETRIE, Fr. The estimation of the amount of pure alkali in the commercial alkalies or alkaline carbonates. The methods employed in alkalimetry may also be applied to the estimation of the alkaline earths and their carbonates. This article will include almost everything that requires to be said under ACIDIMETRY (which *see*), the one series of operations being simply the converse of the other.

Alkalimetrical Methods. These are either (*a*) volumetric, or (*b*) gravimetric; the former are the more frequently followed. For a detailed account of this subject, the reader is referred to Sutton's 'Volumetric Analysis,' fifth ed. (Churchill, 1886), a book which has been freely consulted for the writing of this article.

(*a*) *Volumetric Methods.* An acid and an alkali, or, to speak more generally, an acid and a base, react with one another to produce a salt and water, thus:

$$\underset{\text{Sodium oxide.}}{Na_2O} + \underset{\text{Sulphuric acid.}}{H_2SO_4} = \underset{\text{Sodium sulphate.}}{Na_2SO_4} + \underset{\text{Water.}}{H_2O}$$

Again,

$$\underset{\text{Calcium oxide.}}{CaO} + \underset{\text{Hydrochloric acid.}}{2HCl} = \underset{\text{Calcium chloride.}}{CaCl_2} + \underset{\text{Water.}}{H_2O}$$

Now, since acids turn the blue colouring matter of litmus red, while alkalies reconvert the red into blue, and since salts, such as normal sodium sulphate, have no effect upon the colour one way or the other, it follows that by using a solution of litmus as an indicator (see INDICATOR), we can at once detect the point of neutralisation of an acid by a base. Thus, provided that we know (*a*) the strength of the solution of acid used, and (*b*) its reaction with the alkali, it is a very simple matter to determine the strength of the latter, or *vice versâ*.

Indicators used in Alkalimetry. A considerable number of convenient indicators are known, but only a few need be described here.

(1) *Litmus.* This is sold in the form of small pellets, made up with gypsum. A somewhat elaborate process is required in order to prepare a solution of litmus which shall be excessively delicate towards alkalies and acids, but one which is sufficiently sensitive for all practical purposes can be readily made by digesting 10 to 15 grms. ($\frac{1}{3}$ to $\frac{1}{2}$ oz.) of the finely-powdered commercial product with about 500 c.c. of water for half an hour, pouring the mixture into a cylinder, and allowing the whole to stand over night. By next morning the solid matter will have subsided, and the clear supernatant blue liquid can now either be siphoned off or filtered. The solution must be kept in a bottle to which the air has access, otherwise it gradually decomposes; this is easily managed by cutting a small slit in the cork which closes the bottle. The sensitiveness of the solution is tested by colouring some water with a few drops of it, and then adding one drop of an excessively dilute solution of acid, which should at once turn it red. Litmus answers admirably as an indicator in the absence of free carbonic acid, but, when the latter is present, it interferes with the production of the blue colour, thus rendering it necessary that the solution should be boiled, and the carbonic acid expelled during titration. Bearing this in mind, however, it may be used in the estimation of all the alkalies and alkaline earths and their carbonates, and of sulphuric, hydrochloric, nitric, and oxalic acids.

Blue litmus paper is prepared by drawing strips of filter paper through a solution of litmus and hanging them up (*e.g.* on glass rods) to dry, after which they can be cut into small pieces. *Red litmus paper* is prepared in the same way from a solution of litmus which has just been rendered acid by the addition of a few drops of mineral acid.

(2) *Turmeric.* The yellow dye curcumin of the turmeric root is turned orange by alkalies, the original yellow colour being restored by acids. A solution of it is never used, but turmeric paper frequently is, the latter being prepared from the alcoholic solution of commercial turmeric, exactly as given above for litmus paper.

(3) *Methyl-orange*, or *Orange III* (a benzene derivative), which acids in the slightest excess turn pink and alkalies a faint yellow, possesses the great advantage over litmus that its solution is affected neither by carbonic acid nor by sulphuretted hydrogen in the cold. On the other hand, it cannot as a rule be employed with hot liquids, and mineral acids alone can be titrated with this indicator. It answers admirably for ammonia and its salts. A convenient strength for the solution is 1 grm. per litre (1 gr. per 1000 grain measures). One or two drops of such a liquid suffice for the titration of ordinary volumes of colourless liquids. The change in the colour being very delicate, highly tinted liquids are inadmissible (*Sutton*).

(4) *Phenol-phthaleïn.* Soluble in alcohol of 50%. A convenient solution is made by dissolving 1 grm. in a litre. A few drops of this indicator in an ordinary solution show no change of colour, but the merest trace of alkali turns the solution purple-red. It cannot be used for the titration of free ammonia, or of potash and soda in presence of ammonium salts, but it is especially useful for the titration of solutions of organic acids (*Sutton*).

(5) *Rosolic Acid.* Pale yellow; turned violet-red by alkalies. Suitable for the titration of mineral, but not of organic, acids.

All the indicators which have been named may be used for mineral acids and for fixed alkalies. For a detailed account of indicators used in alkalimetry, and the particular cases in which they may be employed, the reader is referred to R. T. Thompson's investigations, the results of which are quoted in Sutton's book.

1. *Normal Solutions of Acid and Alkali* (see NORMAL SOLUTIONS). It is necessary in alkalimetrical and acidimetrical titrations to have at least one solution of acid and one of alkali whose strength has been determined with the utmost care. One or two may be described here.

Normal Sodic Carbonate (53 grms. Na_2CO_3 per litre). This is made by dissolving 53 grms. of the pure dry salt (Na_2CO_3), prepared by heating the crystallised salt ($Na_2CO_3 + 10H_2O$) to redness in a platinum basin, and making the solution up to 1 litre. Should only the bicarbonate ($NaHCO_3$) be available, the solution may be prepared by heating about 85 grms. of the latter salt (pure) to dull redness in a platinum basin for fully 10 minutes, taking care to avoid fusion, when half the carbonic acid present is expelled, thus:

$$2NaHCO_3 = Na_2CO_3 + H_2O + CO_2.$$

The whole is then allowed to cool in an exsiccator and placed in the balance, when the residual carbonate (Na_2CO_3) will be found to weigh nearly 53 grms. Any excess is removed as quickly as possible, and the above amount then dissolved in water as before.

2. *Normal Caustic Potash* (56 grms. KOH per litre);

3. *Normal Caustic Soda* (40 grms. NaOH per litre). These solutions are made by dissolving the above amounts of potash or soda in water, making the solution up to about 900 to 950 c.c., determining the strength of this with normal acid (using methyl-orange as indicator for choice), and then adding the requisite amount of water to make the solutions normal. Since the caustic potash and soda of commerce always contain some water and carbonate, it is not sufficient merely to weigh out the theoretical quantity.

4. *Semi-normal Ammonia* (8·5 grms. NH_3 per litre). Sutton ('Volumetric Analysis,' p. 39) recommends this solution as being cleanly, not readily absorbing carbonic acid, and retaining its strength well for two or three months when kept in a cool place in a tightly-stoppered bottle. It has the further advantage of being readily prepared by simply diluting a strong solution of ammonia of known specific gravity with the requisite amount of distilled water. A normal solution cannot be used with safety, owing to evaporation of the gas at ordinary temperatures. Even $\frac{N}{2}$ ammonia requires titration from time to time against correct N. acid. $\frac{N}{10}$ ammonia keeps its strength for a long time in well-closed bottles.

5. *Normal Oxalic Acid* (72 grms. $H_2C_2O_4 + 3H_2O$ per litre). The commercial acid usually contains oxalates of potassium and calcium. It should therefore be powdered and treated with a quantity of lukewarm water sufficient to dissolve only a portion of it, the solution filtered, and the filtrate set aside to crystallise. The crystals of oxalic acid ($H_2C_2O_4 + 3H_2O$) are then drained from adhering mother-liquor, and thoroughly dried in the air by pressing them between folds of filter-paper, the latter being renewed as required. The crystals must not be heated. As the amount of water of crystallisation in oxalic acid is said to vary, the strength of the normal solution should be verified from normal alkali. Further, since dilute solutions of oxalic acid are very unstable, decinormal and centinormal solutions of it must be made up at the time they are wanted for use.

6. *Normal Sulphuric Acid* (49 grms. H_2SO_4 per litre). About 30 c.c. of pure sulphuric acid of 1·84 sp. gr. are added to water (*not* the reverse) uuder stirring, and the whole is diluted to 1 litre. If a normal solution of sodic carbonate or caustic alkali is at command, the strength of the sulphuric acid can be determined from this. If not, then a certain amount of dilute acid (say 5 grms. or 5 c.c.) is accurately weighed or measured out, and the acid present determined as barium sulphate, by precipitation with barium chloride.

7. *Normal Hydrochloric Acid* (36·4 grms. HCl per litre). An approximately normal solution is obtained if about 181 grms. of acid of 1·10 sp. gr. (*i. e.* containing 21·2% HCl) are diluted to a litre. The actual strength of this solution may then be determined either (as above) by means of normal alkali, or by precipitating 5 grms. or 5 c.c. of it by means of silver nitrate, and igniting and weighing the resulting silver chloride.

A word may be said here with regard to the relative advantages of these standard solutions of alkali and acid. When methyl-orange is available as an indicator, it is better to use a solution of sodic carbonate rather than one of caustic potash, but the converse when only litmus can be had. Of the acids, sulphuric acid can be readily bought pure, and its dilute solution is not affected by boiling. On the other hand, it yields insoluble sulphates with the alkaline earths and their carbonates, which is a drawback to its use in estimating these. The discretion of the experimenter must assist him here in his choice of acid and alkali.

The Analytical Process. Suppose it is desired to determine the total percentage of alkali (Na_2O) in a soda ash (commercial anhydrous carbonate of soda). The sample to be tested is drawn from as near the centre of the cask as possible, and placed in a dry stoppered bottle (see SAMPLING). A convenient quantity is then rapidly reduced to coarse powder, and a portion of it weighed out and shaken up with water until the solution is sufficiently dilute (say 10 grms. of soda ash in a litre). Of this solution, an amount is measured out from a burette or pipette which will suffice to neutralise 15 to 20 c.c. of the normal acid solution. Should the solution of the soda ash be muddy, the flocculent matter is allowed to settle before drawing off the portions to be tested; the volume of this solid matter may be neglected.

(*a*) Using methyl-orange as indicator. The N. acid is simply run into the *cold* alkaline liquid (contained, for choice, in a small flask and fre-

quently shaken) until the solution shows a faint pink colour, which marks the point of neutralisation. These changes of colour are best seen by placing the flask below the burette on a piece of white paper, and having a second piece to form a background.

(*b*) Using litmus as indicator. As the carbon dioxide (CO_2) liberated from the alkaline carbonate is a disturbing element here, the titration has to be done more cautiously, and the liquid heated to boiling after each addition of acid, so as to expel all the liberated gas. The end point is marked by the hot liquid retaining a wine-red colour; any further addition of acid would turn it bright red, and further addition of alkali, blue. Or, it is often convenient to add at once an excess of N. acid, boil off all carbon dioxide, and titrate back to the neutral point with N. caustic alkali, when the end change is very sudden and well marked. Another advantage of this procedure is that the excess of acid decomposes at once any traces of sulphides which may be present, the sulphuretted hydrogen evolved from which would tend to bleach the litmus; if necessary, a few additional drops of the latter can be added towards the end of the operation. This plan, for example, must always be followed in estimating the total alkali (excepting that present, as chloride and sulphate) in black ash and alkaline mother-liquors generally, which contain much sulphide, &c. (See *below*.) In conjunction with the use of litmus solution, it is frequently advantageous to test the liquid, when it comes near to being neutral (especially if any other organic colouring matter is present), by moistening slips of litmus and turmeric paper with a drop of it, and observing whether these are affected any more than they would be by water alone. Should this titration be done in the cold, the results would be quite misleading, since carbon dioxide, much of which the liquid retains in solution until it is well boiled, colours blue litmus a wine red.

Example. 10·0 grms. of soda ash were dissolved in water, and the solution made up to a litre. Of this, two portions of 100 c.c. each (= 1 grm. soda ash) were taken for titration:

(*a*) The first 100 c.c. required 14·3 c.c. N. sulphuric acid to neutralise it.

(*b*) The second 100 c.c. required 14·1 „ N. sulphuric acid to neutralise it.

Mean = 14·2 c. c.

Now, 1 c.c. N. sulphuric acid contains: 0·049 grm. H_2SO_4;

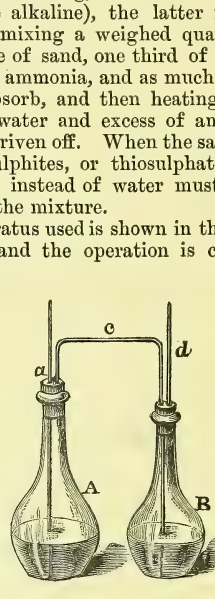
Equivalent to . 0·031 „ Na_2O.

Therefore 1 grm. soda ash contains $14{\cdot}2 \times 0{\cdot}031 = 0{\cdot}4402$ grm. Na_2O, *i. e.* the soda ash contains 44·02 % soda (Na_2O).

[*Note.* This method of estimation, therefore, gives the percentage of alkaline oxide (Na_2O), which is present in the sample as caustic alkali ($NaOH$), or carbonate (Na_2CO_3), and also the small amounts which are present as sulphide (Na_2S), sulphite (Na_2SO_3), and thiosulphate ($Na_2S_2O_3$); it does not, however, affect any which is present as chloride ($NaCl$), or sulphate (Na_2SO_4)].

b. Fresenius and Will's Gravimetric Method. This is applicable to the normal carbonates of the alkalies (therefore to soda ash), and depends upon the determination of the loss of weight which ensues upon treating a weighed quantity of the carbonate with excess of strong sulphuric acid. Should any bicarbonate be present, it must first be converted into normal carbonate by heating (see p. 66). Further, should the sample contain any caustic alkali (which is readily proved by adding an excess of barium chloride to its aqueous solution and filtering, when the filtrate will be found to be alkaline), the latter must be carbonated by mixing a weighed quantity with an equal volume of sand, one third of its volume of carbonate of ammonia, and as much water as the mass will absorb, and then heating the mixture till all the water and excess of ammonium carbonate are driven off. When the sample contains sulphides, sulphites, or thiosulphates, a solution of ammonia instead of water must be used for moistening the mixture.

The apparatus used is shown in the accompanying figure, and the operation is carried out as



follows:—*A* and *B* are two small flasks fitted with tubes as above, the smaller flask *B* being about half filled with concentrated sulphuric acid, while *A* contains a solution of the weighed quantity of alkaline carbonate, diluted with water so as to fill the flask about one third. To the ends of the tubes *a* and *d*, which must fit tightly into the corks, are attached small stoppers *x x*, consisting of pieces of thin india-rubber tubing about half an inch long, closed by small bits of glass rod rounded at the ends; these can be taken off when required. Flasks *A* and *B* are now tightly closed by their corks, *a* and *d*, stoppered as above, and the whole weighed. To make sure that the apparatus is now air-tight, the stopper on *d* being removed, a somewhat long piece of india-rubber tubing with glass mouthpiece is attached to *d*, and a few bubbles of air are sucked out of *A*; this causes the acid to rise a little in tube *c*. If its level in that tube now remains constant for a few minutes, the apparatus is obviously air-tight; if it does not, then the defect must be sought out and remedied. Suction is now again cautiously applied to the tube *d*, and a little of the acid in *B* made to flow over into *A*, the quantity being proportionate to the vacuum produced by suction, and capable of being regulated at will. No sooner does the acid come in contact with the carbonate in *A* than the evolution of carbon dioxide commences, and this latter—from the construction of the apparatus—having to pass through the concentrated

sulphuric acid, is thoroughly dried before it can escape through the tube *d* into the atmosphere. Whenever the effervescence flags, a little more acid is sucked over until the whole of the carbonate is decomposed; finally, an additional quantity is made to pass into *A*, so as to raise the temperature considerably, and thus expel all the gas absorbed by the liquid during the operation. As soon as this is effected the stopper on *a* is removed, and the rubber tubing with glass mouthpiece again attached to *d*, and slow suction applied until all the carbonic acid in the apparatus is replaced by air. The stoppers *x x* are now replaced, and the whole apparatus allowed to cool; when it is cold, one of the stoppers is removed for a moment, then put on again, and the apparatus weighed. The loss in weight represents the amount of carbon dioxide (CO_2) which was originally present in the alkaline carbonate, and from this the percentage of the latter can be readily calculated, thus:

$$CO_2 : Na_2CO_3 :: 44 : 106$$
$$CO_2 : K_2CO_3 :: 44 : 138.$$

If flasks *A* and *B* are taken sufficiently small, the whole apparatus, when filled for the operation, need not weigh more than 70 grms. (1000—1100 gr.), and it can therefore be weighed on a delicate chemical balance. Very accurate results are obtained when the analysis is carefully performed, the amount of carbon dioxide to be estimated not being too small. Care must be taken to liberate the gas gradually in *A*, so that it shall escape slowly through the sulphuric acid in *B*, and thus be thoroughly dried. Since much of the soda of commerce contains sulphides, sulphites, or thiosulphates, their presence may be taken for granted, and the preliminary testing for them omitted. In this case a small quantity of neutral chromate of potash (K_2CrO_4) is added at once to the solution of alkaline carbonate in flask *A*, by means of which the sulphides, &c., are oxidised during the operation to sulphates, sulphur, and water, and thus all escape of sulphuretted hydrogen and sulphur dioxide along with the carbonic acid prevented (*Fresenius*). Should the sample under analysis contain much chloride, no more sulphuric acid than is necessary must be drawn over into flask *A*, and the residual carbon dioxide must be expelled from it by gentle warming over a water bath, instead of by the addition of excess of acid; otherwise hydrochloric acid gas is set free, and escapes along with the carbon dioxide.

[*Note.* The presence of *sulphides* in any sample of alkali can be at once detected by the evolution of sulphuretted hydrogen on the addition of excess of dilute sulphuric acid; this is recognised (*a*) by its odour, (*b*) by its blackening action on paper moistened with a solution of acetate of lead. *Sulphites* and *thiosulphates:* if these are present in any appreciable quantity, the addition of dilute hydrochloric acid in excess to the solution of the alkali causes the evolution of sulphur dioxide, with its characteristic odour, in both cases, together with precipitation of sulphur in the case

Table of Acidimetrical and Alkalimetrical Equivalents.

Parts by weight.	
36·4	Hydrochloric acid (HCl).
63	Nitric acid (HNO_3).
60	Acetic acid (HC_2H_3O).
22	Carbonic anhydride (CO_2).
49	Sulphuric acid (H_2SO_4).
72	Oxalic acid, crystallised ($H_2C_2O_4 + 3H_2O$).
75	Tartaric acid, crystallised ($H_2C_4H_4O_6$).
67	Citric acid, crystallised ($2C_6H_8O_7 + H_2O$) (or $2H_3.C_6H_5O_7, + H_2O$).

are equivalent to and neutralised by

Parts by weight.	
17	Ammonia, gaseous, NH_3.
57	Normal ammonium carbonate, $(NH_4)_2CO_3 + H_2O$.
79	Acid ammonium carbonate, NH_4HCO_3
63·5	Ammonium sesquicarbonate, $(NH_4)_2CO_3,2(NH_4)_2CO_3$.
47	Potassic oxide (potash), K_2O.
56	„ hydrate (caustic potash), KOH.
69	„ carbonate, K_2CO_3.
87	„ „ (crystallised), $K_2CO_3 + 2H_2O$.
100	„ bicarbonate, $KHCO_3$.
31	Sodic oxide (soda), Na_2O.
40	„ hydrate (caustic soda), NaOH.
53	„ carbonate, Na_2CO_3.
143	„ „ (crystallised), $Na_2CO_3 + 10H_2O$.
84	„ bicarbonate, $NaHCO_3$
15	Lithium oxide (lithia), Li_2O.
24	„ hydrate, LiOH.
37	„ carbonate, Li_2CO_3.
28	Calcium oxide (lime), CaO.
37	„ hydrate (slaked lime), $Ca(OH)_2$.
50	„ carbonate (marble or pure chalk), $CaCO_3$.
52·6	Strontium oxide (strontia), SrO.
60·6	„ hydrate, $Sr(OH)_2$.
73·6	„ carbonate, $SrCO_3$.
76·4	Barium oxide (baryta), BaO.
85·4	„ hydrate, $Ba(OH)_2$.
98·4	„ carbonate, $BaCO_3$.
20	Magnesium oxide (magnesia), MgO.
42	„ carbonate, $MgCO_3$.

of the thiosulphate. *Chlorides* yield a curdy precipitate on addition of excess of nitric acid and nitrate of silver, the precipitate redissolving in ammonia.]

The amount of caustic alkali (NaOH or KOH) present as such in a sample of carbonate (Na_2CO_3 or K_2CO_3) is best determined by Fresenius's method, as follows:—The total amount of pure alkali, both caustic and carbonated, expressed in per cents. of sodium carbonate or potassium carbonate, is ascertained by any of the usual methods. The apparent quantity of alkali per cent. is then determined, without previous treatment of the sample with carbonate of ammonia, by the method of Will and Fresenius. The difference in the results indicates the percentage of caustic alkali present.

For the *estimation of ammonia* in ammonium salts, see AMMONIA.

ALKALOIDS. *Syn.* VEGETABLE ALKALI, ORGANIC BASE; ALKALOÏDES (*pl.*, -IDES, or -IDÆ), L.; ALKALOÏDE, ALCALI ORGANIQUE, Fr. From a chemical point of view alkaloids are regarded as organic bases; being constituted on the type of ammonia. The majority possess alkaline or basic properties, hence make acids neutral and form salts. They may be obtained either from the vegetable or animal kingdom, chiefly the former.

The common characteristics of alkaloids are:—(1) They all contain nitrogen and carbon. (2) Burnt they yield no residue. (3) Solutions of their salts give with iodo-mercurate of potassium (*Meyer's* reagent) a precipitate. (4) With very few exceptions, the pure alkaloid turns red litmus paper blue. In addition most have an acrid or bitter taste, and many are powerful poisons.

Alkaloids may be either fixed or volatile, the former usually containing carbon, oxygen, hydrogen, nitrogen, the latter the same elements but no oxygen.

Numerous artificial alkaloids or amines have been prepared by synthesis, but they are all of the class found in animal organisms, and include such substances as ethylamine, methylamine, and trimethylamine. The constitution of the more complex bases of plant life, and their synthesis, still remain unsolved problems. It is true that new bases have been prepared from those already in existence, but no alkaloid such as morphine, atropine, or quinine, has been built up from elementary material.

The first discovery of an alkaloid was made by Seguin and Derosne, in 1804, and about the same time by Serturner, who announced the presence of morphine, a salifiable base, in opium. Since that period, and especially of late years, the number added to the list has been very large.

Prep. The following general methods of procuring the alkaloids, will be found applicable to such as full directions are not given for, under their respective heads:

1. (When the base is insoluble in water, non-volatile, and existing in the plant in an insoluble form.) The bruised plant is boiled or macerated in water acidulated with hydrochloric or acetic acid, and the liquor, after filtration and concentration is neutralised with an alkali (ammonia, potassa, lime, or magnesia); the resulting precipitate is purified by re-solution in dilute acid, digestion with a little animal charcoal, and subsequent crystallisation, or re-precipitation with an alkali; or the first precipitate is purified by dissolving it once, or, if necessary, several times, in boiling alcohol, which yields the pure alkaloid either on cooling or by evaporation.

2. (When the base is insoluble in water, and non-volatile, but existing in the plant as a soluble salt.) The bruised or sliced plant is boiled or macerated in water, and the filtered liquor precipitated and otherwise treated as before.

3. (When the base is soluble in water, and non-volatile.) An infusion made with very dilute acid, hydrochloric or acetic, is concentrated by a gentle heat; and the residual liquor treated with potassa (or concentrated solution of ammonia) and ether or chloroform conjointly, then shaken well; after repose, the ethereal solution is decanted and evaporated. For those alkaloids which are insoluble in ether (as morphine and cinchonine), the previous process may be adopted.

4. (When the base is both soluble in water and volatile.) The vegetable, in a bruised or divided state, or its extract, is alkalised with potassa and distilled; the distillate is neutralised with dilute oxalic or sulphuric acid, and carefully evaporated to dryness; the residuum is next digested in alcohol, and the resulting tincture agitated with potassa and ether, the former being in quantity just sufficient to seize on all the acid; lastly, the ethereal solution thus formed, on careful evaporation, leaves the alkaloid nearly pure. It may be further purified by cautious distillation.

As some of the alkaloids are soluble in excess of the alkaline precipitant, over-saturation should be carefully avoided; or the precipitant may be used under the form of carbonate or bicarbonate. When lime and magnesia are employed, they are boiled for a few minutes with the solution.

Physiological Action. The alkaloids generally possess great medicinal power; some of them act with terrific energy, and are the most violent poisons with which we are acquainted. Perfectly pure aconitine is about 200 times more poisonous than arsenic, and at least 50 times more poisonous than ordinary medicinal prussic acid. The greater number act on animals in the same way as the plants which produce them, provided they are given in proportionately small doses. Many of them, when judiciously administered, are most valuable medicines.

Pois., Ant., &c. Some of the alkaloids act as narcotic or stupefying poisons; others are classed with the narcotico-acrid poisons, or those which produce both narcotism and irritation of the parts they touch. The general symptoms produced by opium and its preparations may be taken as an example of the former; those from aconite and strychnia, of the latter. In large doses of the greater number, narcotism predominates; in smaller ones, irritation; they are rarely coexistent.—*Treatm.* No common antidote to the effects of this class of substances has yet been discovered. The only safe treatment, of at all general application, is to immediately clear the stomach by means of a strong and quick-acting emetic (as sulphate of zinc or apomorphine), or the stomach-pump, and to administer copious and continued

draughts of astringent vegetable solutions (as of tannin, nut-galls, oak-bark, or what is always at hand—very strong tea or coffee). These may be followed by or combined with a smart purge of castor oil, as soon as the stomach is thoroughly cleared of the poison. M. Bouchardat strongly recommends a solution of iodine, 3 gr., and iodide of potassium, 6 gr., in pure water, 16. fl. oz., in cases of poisoning by OPIUM, ACONITE, COLCHICUM, DEADLY NIGHTSHADE, HEMLOCK, NUX VOMICA, &c., or by the alkaloids obtained from them—ACONITINE, ATROPINE, COLCHICINE, CONINE, MORPHINE, STRYCHNINE, &c., or their salts; but *not* where foxglove or digitalin has been taken. The stomach having been well emptied by an emetic, the solution is to be given by wine-glassfuls for some time; the vomiting being still encouraged during the early part of the administration of the antidote. In the case of narcotics (as opium, morphine, &c.), this is to be followed by the free use of a strong infusion of coffee. According to Dr Garrod, purified animal charcoal is an 'excellent antidote' to many of the alkaloids, including those above enumerated, when taken in poisonous doses; as it not merely absorbs them, but, for the most part, renders them inert. To be serviceable it should be recently prepared and fresh burnt; and should be given in doses of about an ounce at a time, diffused in warm or tepid water, and frequently repeated. The vomiting which follows its use, owing to the warm water, proves advantageous; but after a sufficient time may be lessened by employing less water, or cooler or even cold water. Drowsiness, if present, may be combated by the subsequent use of strong coffee or tea, as before. We have seen this plan succeed in several cases.—*Lesions.* These, like the symptoms, vary. In some cases there are redness and inflammation of the stomach and intestines, and turgescence of the vessels of the lungs and brain; in others, these appearances are either slight or wholly wanting. Wherever there has been much cerebral disturbance, traces of congestion are usually discernible.

Detec., Tests., &c. The identification of the pure alkaloids is extremely simple; but their detection, when combined with organic and colouring matters, is a task of considerable difficulty. One or other of the following plans may be adopted for this purpose:

1. (*Merck.*) The matter under examination is digested, for several hours, with concentrated acetic acid, added in sufficient quantity to produce a strongly acid reaction; the fluid portion is then strained from the insoluble matter, and the latter being washed with water acidulated with acetic acid, the mixed liquors are gently evaporated to dryness in a water bath; the residuum of the evaporation is boiled first with rectified spirit, and next with rectified spirit acidulated with acetic acid; the mixed liquors are again evaporated, the residuum redissolved or diluted with distilled water, and carbonate of soda or potassa added to feebly alkaline reaction, and the whole, after evaporation to the consistence of a syrup, set aside to repose for 24 hours; it is now again diluted with water, filtered, and the insoluble portion washed with cold distilled water, and digested with concentrated acetic acid; this last solution is diluted with distilled water, and decoloured with pure blood-charcoal (if it be necessary); the fluid, either at once, or after cautious evaporation, may then be tested for the alkaloids, in the usual manner. The charcoal previously used should also be tested in the way described below. This method answers admirably with all the NON-VOLATILE ALKALOIDS, and may be applied to the stomach and viscera, and their contents, and to food, &c., in cases of poisoning.

2. (*Stas.*) The suspected matter, in a finely divided state, is digested, at 160°—165° F., with twice or thrice its weight of strong alcohol acidulated (according to the quantity) with ½ dr. to 2 or 3 dr., or more, of pure oxalic or tartaric acid. After a sufficient time, and when the whole has become quite cold, it is thrown on a filter, and the undissolved portion, after being squeezed dry, is washed with strong alcohol. The mixed and filtered alcoholic liquids are then evaporated at a temperature not exceeding 95° F., and, if no insoluble matter separates, the evaporation is continued nearly to dryness; but if fatty or other insoluble matter separates during the process of concentration, the concentrated fluid is passed through a moistened filter, and the filtrate evaporated nearly to dryness, as before. The residuum is next digested with absolute alcohol, in the cold, the insoluble portion, after filtration, washed with alcohol, and the mixed filtrates again evaporated in the air, or in vacuo. The acid residue is now dissolved in a little distilled water, and bicarbonate of sodium added as long as effervescence ensues. To this mixture 4 or 5 times its volume of ether is added, and after lengthened agitation (the bottle or tube being held in a cold wet cloth), the whole is allowed to repose for a short time. A little of the supernatant ether is now removed to a small glass capsule or watch-glass, and allowed to evaporate spontaneously. The evaporation, according to Stas, should be conducted under a bell-glass over sulphuric acid, with or without rarefaction of the air; or in a tubular retort through which a current of air is made to pass. When this leaves oily streaks upon the glass, which gradually collect into a small drop, which emits, when gently heated, a disagreeable, pungent, and stifling odour, the presence of a LIQUID VOLATILE BASE or ALKALOID is inferred; whilst a solid residue or a turbid fluid with small solid particles floating in it, indicates a NON-VOLATILE SOLID BASE. A merely disagreeable animal odour, without pungency, is here disregarded. In either case the blue colour of reddened litmus is permanently restored by the residuum. If no residuum is left on the capsule, some solution of pure soda or potassa is added to the liquid, the whole well agitated for several minutes, and the ether (after repose) decanted; an operation which is repeated with fresh ether a second, third, and even a fourth time. The base, or bases (if any are present), will now be found in the mixed ethereal solution, which is, therefore, tested as before. The presence of an alkaloid being detected, the mixed ethereal solutions are allowed to evaporate spontaneously, care being taken, if a volatile alkaloid be present, to neutralise the liquid with an acid before the final evaporation. The last residuum is then tested for the particular alkaloid present as before

('Bulletin de l'Académie de Méd. Belgique,' ix, 304; 'Jahrb. f. prakt. Pharm.,' xxiv, 313, &c.)

This method, according to Stas, answers well for all the ALKALOIDS which are soluble in ether; including—ACONITINE, ANILINE, ATROPINE, BRUCINE, CODEINE, COLCHICINE, CONINE, DELPHINE, EMETINE, HYOSCYAMINE, NICOTINE, PICOLINE, SOLANINE, STRYCHNINE, VERATRINE, &c. By means of it Stas found nicotine in the heart-blood of a poisoned dog. With such alkaloids as are, however, only very sparingly soluble in ether (as morphine for instance), the result must, necessarily, be doubtful. To detect these, as well as all the alkaloids which are insoluble in ether, it is, therefore, necessary, as directed by Otto, to add to the alkaline fluid left by the decantation of the ether, sufficient solution of soda to dissolve the morphine, &c. (if any has separated), and after the expulsion of the last traces of the ether by a gentle heat, to add a concentrated solution of hydrochlorate of ammonia, and to allow the mixture to repose for some time in the open air. When MORPHINE is present, it separates under the form of small crystals. (Otto's 'How to Detect Poisons.') Or the alkaline liquor may be diluted with distilled water, and treated with charcoal, and this with alcohol in the manner noticed under method 4 (*below*).

4. (*Graham* and *Hoffmann*—slightly modified.) 2 or 3 oz. of purified animal charcoal are digested in about ½ gal. of the (neutral or only slightly acid) aqueous fluid under examination, with frequent agitation, for 10 to 12 hours, or longer. The liquid is then filtered, and the charcoal left on the filter is washed twice with cold distilled water. The charcoal is then boiled for ½ an hour with about ½ a pint of rectified spirit of 80% or 90%; the ebullition being conducted in a flask having a very long tube, open at both ends, fitted air-tight through the cork, to prevent loss of the alcohol by evaporation. The spirit, which now contains the alkaloid (if any was present in the original liquor), is next filtered whilst hot, and the filtrate is submitted to distillation until the whole of the alcohol is removed. A small quantity (commonly a few drops) of solutions of potassa is then added to the residual aqueous liquor, followed by 1 to 2 fl. oz. of pure ether, after which the whole is well agitated for several minutes, and allowed to repose for a short time. Lastly, the supernatant ether is decanted, and allowed to evaporate spontaneously, when the residuum (if any) left in the capsule may be tested by reagents, as before.

This method was devised for the detection of STRYCHNINE and NUX VOMICA in malt liquors; but it is equally applicable to the detection of ANY ALKALOID which is soluble in ether. The CHARCOAL TEST may also be employed to detect alkaloids which are insoluble in ether; but then the base must be sought in the aqueous residuum obtained by the evaporation of the alcohol ('Journ. of the Chem. Soc.,' v, 173).

The presence of the alkaloids and their salts, in clear solutions, may be thus determined:

I. (*Fresenius*). 1. The solution is rendered very slightly alkaline with dilute solution of potassa or soda, added drop by drop:

a. No precipitate is formed; absence of most alkaloids. (See 4, *below*.)

b. A precipitate is formed:—Solution of potassa or soda is added, drop by drop, until the liquid exhibits a strong alkaline reaction:

α. The precipitate redissolves; absence of Brucine, Cinchonine, Narcotine, Quinine, Strychnine, and Veratrine; probable presence of MORPHINE.

β. Precipitate does not redissolve, or not completely; probable presence of one or more of the first six of the above-named alkaloids:—The fluid is filtered from the precipitate, mixed with either bicarbonate of soda or of potassa, gently boiled nearly to dryness, and treated with water. If it dissolves completely; absence of morphine; an insoluble residue indicates MORPHINE.

2. The precipitate 1. *b.* *β.* is washed with cold distilled water, dissolved in a slight excess of dilute sulphuric acid, neutralised with a saturated solution of bicarbonate of soda, and allowed to repose a few hours. Before setting the glass aside the liquor should be well mixed, and the glass stirrer vigorously rubbed against the sides of the vessel.

a. No precipitate; absence of Cinchonine, Narcotine, and Quinine:—The solution is gently evaporated nearly to dryness, and treated with cold water:—If it dissolves completely, pass on to 4; if there is an insoluble residue, it may contain Brucine, Strychnine, or Veratrine. (See 3.)

b. A precipitate:—The filtered fluid is treated as directed at 2 *a.*; the precipitate is washed with cold distilled water, dissolved in a little hydrochloric acid, ammonia is added in excess, and subsequently a sufficient quantity of ether, agitation being had recourse to:

α. The precipitate formed by the ammonia redissolves completely in the ether, and the clear fluid separates into two layers; absence of Cinchonine; probable presence of QUININE or NARCOTINE.

β. The precipitate produced by the ammonia does not redissolve in the ether, or not completely; probable presence of CINCHONINE, and perhaps also of Quinine or Narcotine. The filtered liquid may be tested for these alkaloids as at *α.*

3. The insoluble residuum after the evaporation of the solution 2. *a.*, or of the filtrate 2. *b.*, is now dried in a water bath, and digested with absolute alcohol:

a. It dissolves completely; absence of strychnine; probable presence of BRUCINE, QUININE (?), or VERATRINE:—The alcoholic solution is evaporated to dryness, and, if quinine has been already detected, the residue is divided into two portions, one of which is tested for Brucine, the other for Veratrine.

b. It does not dissolve, or not completely; probable presence of STRYCHNINE, and perhaps also of Brucine and Veratrine:—The filtered fluid is divided into two portions, and tested separately as at *a.*

4. The original liquid 1. *a.* may contain Sali-

cine, a proximate vegetable principle closely allied to the alkaloids :—a portion is boiled with hydrochloric acid for some time; the formation of a precipitate shows the presence of SALICIN. (See 2, *below.*) For further information on this subject, see the admirable 'System of Qual. Chem. Anal.,' by Dr C. R. Fresenius (*Churchill*).

II. (*Larocque* and *Thibierge.*) Terchloride of gold is recommended, by these writers, as a more decisive test for the alkaloids than the 'double chloride of gold and sodium' commonly employed for this purpose. The following are the colours of the precipitates which it produces with the aqueous solution of their salts :—BRUCINE, milk-brown, passing into coffee brown, and lastly chocolate brown :—CINCHONINE, sulphur yellow : —MORPHINE, yellow, then bluish, and lastly violet; in this last state the gold is reduced, and the precipitate is insoluble in water, alcohol, the caustic alkalies, and sulphuric, nitric, and hydrochloric acid; it forms with aqua regia a solution which is precipitated by protosulphate of iron :—QUININE, buff coloured :—STRYCHNINE, canary yellow :—VERATRINE, pale greenish yellow. All these precipitates, with the exception mentioned, are very soluble in alcohol, insoluble in ether, and only slightly soluble in water. Those with morphine and brucine are sufficiently marked to prevent these alkalies from being mistaken for each other; and those with brucine and strychnine are, in like manner, easily distinguishable.

III. Dr Guy, as well as others, have made researches, having for their object the determination of the exact temperature at which the poisonous alkaloids melt and sublime. A very minute speck of the substance is placed on a porcelain plate or copper disc, and a square or oval of microscope-covering glass is placed over it, supported by a thin ring of glass or any other convenient subseance.

Heat is then applied to the plate or copper, and the temperature, as indicated by a thermometer at which the substance fuses or volatilises, is carefully noted.

		Sublime.		Melt.	
		Fahr.	Cent.	Fahr.	Cent.
MORPHINE	Sublime, melt, and yield carbonaceous residue.	330°	165°	340°	171°
STRYCHNINE		345°	174°	430°	224°

		Melt.		Sublime.	
		Fahr.	Cent.	Fahr.	Cent.
ACONITINE	Melt, change colour, sublime, and deposit carbon.	140°	60°	400°	204°
ATROPINE		150°	66°	280°	138°
VERATRINE		200°	93°	360°	182°
BRUCINE		240°	116°	400°	204°
DIGITALIN		310°	154°	310°	154°
PICROTOXIN		320°	160°	320°	160°
SOLANINE		420°	215°	420°	216°

Selmi's Method of extracting Poisonous Alkaloids in Forensic Investigations. The alcoholic extract of the viscera, acidified and filtered, is evaporated at 65° C., the residue taken up with water, filtered to separate fatty matters, and decoloured by means of basic acetate of lead, leaving the solution in contact with the air for 24 hours. It is then filtered, the lead precipitated by means of sulphuretted hydrogen, and the solution after concentration repeatedly extracted with ether. The ethereal solution is then saturated with dry carbonic anhydride, which generally causes a precipitate of minute drops adhering to the sides of the vessel, and containing some of the alkaloids. The ethereal solution is then poured into a clean vessel, mixed with about half its volume of water, and a current of carbonic anhydride passed for about 20 minutes, which may cause the precipitation of other alkaloids not precipitated by dry carbonic anhydride. Usually the whole of the alkaloids present in the ether are thrown down by these means, but if not, the solution is dehydrated by agitation with Barium oxide, and then a solution of tartaric acid in ether added to the clear liquid, taking great care not to employ excess of acid. This throws down any alkaloid that may remain. In order to extract any alkaloids that may still remain in the viscera, they are mixed with Barium hydrate and a little water, and then agitated with purified amylic alcohol; the alkaloids may subsequently be extracted from the alcohol by agitation with very dilute sulphuric acid.

A knowledge of the different solubilities of the alkaloids will be found an important auxiliary in their analysis. The following is a summary of the relative solubility of the most important of them. The figures denote the number of parts of the liquid required for their solution :

Absolute Alcohol. Strychnine insoluble; brucine soluble.

Amylic Alcohol. Solanine (1061); digitalin sparingly soluble; morphine (133); strychnine (122); veratrine, brucine, atropine, aconitine, and picrotoxin, freely soluble.

Chloroform. Solanine (50,000); morphine (6550); strychnine (8); the rest freely soluble.

Ether. Solanine (9000); morphine (7725) strychnine (1400); aconitine (777); brucine (440); veratrine (108); atropine, picrotoxin, and digitalin, very soluble.

Digitalin and picrotoxin, although not alkaloids, are inserted in the above list, because they have a general similarity in physical properties to them and for the convenience of the toxicologist.

Water (*cold*). Strychnine (8333); veratrine; (7860); morphine (4166); aconitine (1783); solanine (1750); brucine (900); atropine (414) picrotoxin (150); digitalin very soluble.

The principal Alkaloids and their Salts, in the state of powder, or with 'conine' and 'nicotine,' in

the state of an oily looking liquid, may be thus distinguished:

1. *a.* The powder is treated with nitric acid:— It is coloured red; probable presence of Brucine, Morphine. If the reddened acid becomes violet on the addition of 'protochloride of tin,' it is BRUCINE. If the powder is fusible without decomposition, and strongly decomposes iodic acid, it is MORPHINE; if it is not fusible without decomposition, and does not decompose iodic acid, it is STRYCHNINE.

b. If instead of a red, the powder strikes a green colour with nitric acid, it is SOLANINE; if it is insoluble in 'ether,' and not reddened by 'nitric acid,' it is EMETINE; if soluble in ether, not reddened by 'nitric acid,' but melts when heated, it is ATROPINE; if it is thus affected by ether or nitric acid, but does not volatilise, it is VERATRINE. (See 2, *below.*)

2. *a.* The powder, or (with 'conine and nicotine') concentrated liquor, is treated with a drop or two of concentrated sulphuric acid:—A red colour is produced; probable presence of Brucine, Nicotine, Salicine, or Veratrine. If the reddened mixture has at first a roseate hue, turning deep red on the addition of nitric acid, it is BRUCINE; if the original substance moistened with solution of potassa evolves the odour of tobacco, it contains NICOTINE; if the red colour produced by the acid is permanent and of an intense blood-hue, and the powder agglutinates into lumps like resin, it is SALICIN; if the colour is at first yellowish, changing to blood-red, and ultimately to crimson and violet, it is VERATRINE.

b. If instead of the substance being 'reddened' by strong sulphuric acid, no particular action ensues in the cold, it contains either Conine or Strychnine; if a small fragment of bichromate of potassa being now dropped in, produces a rich violet colour, it is STRYCHNINE; if the original matter on being heated, or treated with solution of potassa, evolves a penetrating, disagreeable odour, somewhat analogous to that from 'hemlock,' or to a mixture of those from tobacco and mice, it is CONINE.

"*Reactions with Ceroso-ceric Oxide.* This oxide exhibits characteristic colours with several alkaloids, especially with STRYCHNINE. When strong sulphuric acid is poured upon strychnine, and then a small quantity of ceroso-ceric oxide added, a fine blue colour is produced, similar to that which strychnine exhibits with potassium bichromate, but much more permanent. The blue colour gradually changes to cherry-red, and then remains unaltered for several days. This reaction is capable of detecting one part of strychnine in a million parts of liquid. BRUCINE similarly treated acquires an orange colour, gradually changing to yellow; MORPHINE, olive brown, finally brown; NARCOTINE, brown cherry red, finally wine red; CODEINE, olive green, finally brown; QUININE, pale yellow; CINCHONINE and THEINE remain colourless; VERATRINE becomes reddish brown; ATROPINE, dingy yellowish brown; SOLANINE, yellow at first, finally brownish; EMETINE, brown; COLCHICINE, first green, then dirty brown; ANILINE, after a long time, acquires a blue colour extending from the edges inwards; CONINE becomes light yellow. PIPERINE colours the sulphuric acid blood red, and is turned dark brown, almost black by the cerium oxide" (*Sonnenschein*).

"*Reactions with Picric Acid.* This acid is a very good precipitant for alkaloids, affording a very delicate test for many of them, and may perhaps also serve for separating them one from another. The precipitation takes place even in solutions containing a large excess of sulphuric acid, and is sometimes complete. *Precipitated* are, BRUCINE, STRYCHNINE, VERATRINE, QUINIDINE, CINCHONINE, and most of the opium alkaloids" (*Hager*).

The presence of one or more of the alkaloids being shown by any of the preceding methods, a portion of the original clear solution or powder, or of the precipitates or filtrates above referred to, must be treated with their characteristic tests, as given under the individual notices of these articles, so as to set at rest all doubt as to their identity. No single test must ever be relied on as a positive proof. The presence of Brucine, Morphine, and Strychnine may be determined in substances which, after being mixed with the salts of these alkaloids, have undergone the acetous, vinous, or putrefactive fermentation, as shown by Orfila, MM. Larocque and Thibierge, and many other eminent chemists and toxicologists, and confirmed, in numerous cases, by our own experiments. Opium and morphine may thus be readily detected in beer, wine, soup, and milk; with cocaine the case is different, it must be sought quickly, as in a few days it is destroyed. A paper by Professor DRAGENDORF in the 'American Chemist' for April, 1876, may be consulted with advantage.

Concluding Remarks. It is a singular fact that none of the organic bases found in plants have yet been formed artificially, although several analogous substances have been thus produced. Closely allied to the alkaloids there also exists an extensive series of neutral proximate principles, which differ from those substances chiefly in the absence of basic properties, and in most of them being destitute of nitrogen. They are usually bitter, and, like the alkaloids, generally represent the active properties of the plants in which they are found; whilst some of them possess considerable medicinal energy. Of this kind are asparagin, strophanthin, elaterin, gentianin, picrotoxin, salicin, &c. These two classes of bodies, though actually distinct, are frequently confounded. See ALKALI, ORGANIC BASES, POISONS, PROXIMATE PRINCIPLES, VEGETABLES, NOMENCLATURE, &c.; also the individual alkaloids under their respective heads.

Alkaloids of Aconite. The nature of the active principle of aconite root does not appear to have been satisfactorily determined. Messrs. Groves, Wright, and Williams contend that the *Aconitum napellus* yields an active crystalline alkaloid, which they distinguish as *Aconitine*, and to which they assign the formula $C_{33}H_{43}NO_{12}$; they add that additionally the root contains more or less of another active alkaloid, which they term *Pseudaconitine*, and which is represented by the formula $C_{36}H_{49}NO_{11}$; they also assert that the extract of the roots contains varying quantities of certain decomposition products resulting from the saponification of the above bases by the acids, which are produced by the breaking up of part of

the aconitine. The name of these decomposition products is *Aconine* and *Pseudaconine.* Of *Aconitum ferox* they report that it yields a comparatively large quantity of *Pseudaconitine* and a small quantity of *Aconitine.* They further affirm that the so-called aconitine of commerce is a mixture of true aconitine and pseudaconitine with variable quantities of their alteration products, aconine and pseudaconine, and of certain amorphous unnamed alkaloids.

Messrs Paul and Kingzett contest the accuracy of these deductions, and dispute the correctness of the formula given to aconitine. Dr Paul doubts whether the alkaloid to which the active properties of the root are ascribed has ever yet been obtained in an isolated condition. He thinks it probable that the substance obtained from aconite root was to a great extent a salt of an acid, like aconitic acid. For further information the reader is referred to the 'Pharmaceutical Year-Book' for 1873, 1874, 1875, 1876, and 1877.

AL'KANET. *Syn.* ANCHU'SA, L.; ORCANETTE, Fr.; ORKANET, Ger.; OR'CHANET*, DYER'S AL'KANET, D. BU'GLOSS*. The *Anchu'sa tincto"ria* (Willd.; *Lithosper'mum tincto"rium*—Linn.), a deciduous herbaceous plant, belonging to the Nat. Order *Boraginaceæ*, with a perennial, dark blood-red root.—*Hab.* Asia Minor, Greece, Hungary, &c. It is also largely cultivated in the neighbourhood of Montpellier. The dried root (ALKANET ROOT; RADIX ANCHUSÆ, R. A. TINCTORIÆ) is chiefly imported from the Levant. It contains a beautiful blood-red colour, which it freely gives out to oils, fats, wax, spirits, essences, and similar substances, by simply infusing it in them, and is consequently much employed to colour these articles. Wax tinged with it, and applied on warm marble, stains it of a rich flesh-colour, which sinks deep into the stone, and possesses considerable durability. Its spirituous tincture also imparts a deep red to marble.

Prop., &c. The colouring matter of alkanet was regarded by Pelletier as a fatty acid (ANCHUSIC ACID); but it has since been shown to be a species of resin (ANCHUSINE, PSEUDO-ALKANINE, P.-ALKANIUM). According to Dr John, good alkanet root contains 5½ per cent. of this substance. Anchusine melts at 140° Fahr.; is scarcely soluble in water, to which it only imparts a dirty red colour, but is very soluble in alcohol, oils, and acetic acid. Alkalies turn it blue. It is found wholly in the root-bark. In selecting this article, the smaller roots should therefore be chosen, as they possess more bark than the larger ones, in proportion to their weight. Exposure to ammoniacal fumes, or even handling it much with the fingers, changes its red to a crimson or purplish hue.

Uses, &c. It is much employed by druggists and perfumers to colour oils, lip-salves, plasters, pomatums, &c.; by varnish-makers, to tinge their varnishes and lacquers; by statuaries to stain marble; by dairy-farmers, to colour cheese; by wine merchants and bottlers (in the form of tincture), to stain beforehand the corks of their port-wine bottles, in order to imitate the effects of age, and as colouring and flavouring for factitious port wine; and by dyers and others. A species of crimson rouge was formerly prepared from it (hence its name).

ALLANTOIN, $C_4H_6N_4O_3$, which occurs in the amniotic fluid of the cow, is found in minute traces in normal urine after fresh food, and is more abundant during the first weeks of life and during pregnancy.

Prop. Shining, prismatic crystals, decomposed by ferments into urea, ammonium oxalate, and carbonate, and another as yet unknown body.

ALL-HEAL. A name applied to various plants: the mistletoe (Pliny); an umbelliferous plant, the *Opoponax chironium; Valeriana officinalis;* milfoil or yarrow; *Prunella vulgaris* (also called self-heal); woundwort, *Stachys palustris* (*Gerard*).

ALLIA'CEOUS (-sh'us). *Syn.* ALLIA'CEUS, L.; ALLIACÉ, AILIACÉ, Fr.; KNOBLAUCHARTIG, &c., Ger. Garlick-like; an epithet applied to substances having the odour or properties of garlic or onions.

Alliaceous Plants. Chives, garlic, leeks, onions, rocambole, shallots, &c.

ALLIGA'TION. *Syn.* ALLIGA'TIO, L. In *commercial arithmetic,* a rule for ascertaining the price or value of mixtures, and for determining the proportions of the ingredients that must be taken to produce mixtures of any given price, value, or strength. The first is called ALLIGATION ME'DIAL; the second, ALLIGATION ALTERN'ATE. Its principles and applications are explained under MIXTURES (Arithmetic of).

ALLOP'ATHY. *Syn.* ALLOPA'THIA, L. (from ἄλλος, *other, different,* and πάθος, *affection* or *disease,* Gr.); ALLOPATHIE, Fr. In *medicine,* the method of curing disease by the use of remedies which tend to produce a condition of the system, either differing from, opposed to, or incompatible with the condition believed to be essential to the disease it is sought to cure. It is commonly employed to distinguish the ordinary system of medical practice from homœopathy (which *see*). Hence (an) ALLOP'ATHIST, and the corresponding adjective ALLOPATH'IC (*allopath'icus,* L.).

ALLOT'ROPY. *Syn.* ALLOT'ROPISM, ALLOTRO'PIA, ALLOTROPIS'MUS, L. Literally, a difference in character; another form of the same substance. In *chemistry,* a term invented, by Berzelius, to express the state or condition, or the change of character, assumed by certain substances at different temperatures, or under different treatment, whilst their nature and composition continue the same. It more particularly relates to colour, hardness, solubility, texture, &c. Boron, carbon, silicon, iron, sulphur, and phosphorus, afford striking examples of the changes here referred to.

ALLOXANTIN, $C_8H_4N_4O_7 + 3H_2O$. A crystalline substance obtained, among other methods, by the action of nitric acid upon uric acid. It belongs to the class of compounds known as the di-ureides. When heated with ammonia it is converted into murexide (the acid ammonium salt of uric acid), which yields a purple solution. See URIC ACID.

ALLOY (from the French *allier,* to blend or unite). *Syn.* ALLIAGE, Fr.; LEGIRUNG, VERMISCHUNG DURCH SCHMELZEN, Ger. (See the article on ALLOYS in 'Watt's Dictionary of Chemistry,' 2nd edit., by Professor W. Ramsay, which has been freely consulted.) Alloys are compounds or mixtures of the metals with each

other; those containing mercury are termed amalgams (see AMALGAMS). Some metals, when fused together, mix in all proportions with one another, *e.g.* silver with gold, copper, or lead; others do not, for instance, copper cannot be readily united with iron. It usually happens, however, in the case of those metals which do not mix completely when melted, that the one takes up a small quantity of the other; thus iron absorbs $\frac{1}{500}$th of its weight of silver, with the formation of a homogeneous alloy.

Prep. No general rules can be given for the preparation of alloys, which must be referred to individually for this. Alloys of metals which differ greatly in fusibility are usually prepared by adding the more fusible one, either in the molten state or unmelted in small portions at a time, to the less fusible, the latter being itself either melted or heated to the lowest possible temperature at which union will take place between the two. The fusion is usually effected under a flux, so as to avoid volatilisation and exposure of the metals to the air. Thus, in melting lead and tin together for solder, resin or tallow is thrown upon the surface, and in tinning copper, the surface is rubbed with sal ammoniac, charcoal being used for the same purpose in certain other cases.

Properties. The physical properties of alloys are in some cases almost the mean of those of their constituent metals, but in other cases they differ widely, *e.g.* in the case of the alloys of copper and tin. Matthiessen, to whom we owe most of our knowledge on this subject, divides all metals into two classes, viz. (1) those which impart to an alloy their own physical properties to a greater or less degree, according to the proportion in which they are present in the alloy; and (2) those which do not come under this heading. The first class comprises the metals lead, tin, zinc, and cadmium, and the second in all probability the other metals. The alloys themselves may likewise be divided into three groups:—(*a*) those made from metals belonging to class (1); (*b*) those made from metals of class (1) with others of class (2); and (*c*) those made with metals belonging to class (2) alone. Bloxam and Huntingdon ('Metals') consider that alloys in all probability consist usually of definite chemical compounds of one metal with another, dissolved in or mingled with an excess of one of the constituents over and above the quantity which is actually required to take part in the formation of a chemical compound. "On the whole there appears to be a marked analogy between alloys and solutions" (*Ramsay*).

The melting point of an alloy is generally lower than the mean melting point of the component metals, and it usually possesses more tenacity and hardness than corresponds to the mean of its constituents. Matthiessen found that spirals of hard-drawn wire made of copper, silver, gold, or platinum, become nearly straightened when stretched by a moderate weight, while wires of equal dimensions composed of copper-tin (12% of tin), silver-platinum (36% of platinum), and gold-copper (84% of copper), scarcely undergo any permanent change in form when subjected to tension by the same weight.

The same chemist gives the following approximate results upon the tenacity of wires of certain metals and alloys hard drawn through the same gauge (No. 23):

					lbs.
Copper,	breaking strain	for double	wire .		25—30
Tin	,,	,,	,,	under	7
Lead	,,	,,	,,	,,	7
Tin-lead (20% lead) ,,			,,	about	7
Tin-copper (12% copper)			,,	,,	7
Copper-tin (12% tin)			,,	,,	80—90
Gold	,,	,,	,,		20—25
Gold-copper (8·4% copper)			,,		70—75
Silver	,,	,,	,,		45—50
Platinum	,,	,,	,,		45—50
Silver-platinum (30% plat.)			,,		75—80

On the other hand, their malleability, ductility, and power of resisting oxygen are generally diminished. The alloy formed of two brittle metals is always brittle; that of a brittle and a ductile metal, generally so; and even two ductile metals sometimes unite to form a brittle compound. The alloys formed of metals having different fusing-points are usually malleable whilst cold and brittle whilst hot. The action of the air on alloys is generally less than on their simple metals, unless the former are heated. A mixture of 1 part of tin and 3 parts of lead is scarcely acted on at common temperatures, but at a red heat it readily takes fire, and continues to burn for some time like a piece of bad turf. In like manner, a mixture of tin and zinc, when strongly heated, decomposes both moist air and steam with almost fearful rapidity.

The specific gravity of alloys is never the arithmetical mean of that of their constituents, and in many cases considerable condensation or expansion occurs in their formation. When there is a strong affinity between two metals, the density of their alloy is generally greater than the calculated mean, and *vice versâ,* as may be seen in the following table:

Alloys having a density

Greater than the mean of their constituents:	Less than the mean of their constituents:
Copper and bismuth,	Gold and Copper,
„ palladium,	„ iridium,
„ tin,	„ iron,
„ zinc,	„ lead,
Gold and antimony,	„ nickel,
„ bismuth,	„ silver,
„ cobalt,	Iron and antimony,
„ tin,	„ bismuth,
„ zinc,	„ lead,
Lead and antimony,	Nickel and arsenic,
Palladium and bismuth,	Silver and copper,
Platinum and molybdenum,	Tin and antimony,
Silver and antimony,	„ lead,
„ bismuth,	„ palladium,
„ lead,	Zinc and antimony.
„ tin,	
„ zinc.	

"Every alloy," says Dr Ure, "is, in reference to the arts and manufactures, a new metal, on account of its chemical and physical properties. A vast field here remains to be explored. Very slight modifications often constitute very valuable improvements upon metallic bodies." See ANALYSIS, ASSAYING, BRASS, BRONZE, ELECTROTYPE, GERMAN SILVER, GOLD, METALS, SPECIFIC GRAVITY, &c.

The following table gives the constituents of the more important alloys:

Table of the principal Alloys.

(For the proportions of the component metals, refer to the alloys under their respective heads.)

NAMES.	COMBINING METALS.
ALBATA	See German silver.
ALUMINIUM-BRONZE	Copper and aluminium.
AMALGAMS	Mercury and other metals.
BATH-METAL	Copper and zinc.
BELL-METAL	Copper and tin.
BRASS	Copper and zinc.
BRITANNIA-METAL	Tin with antimony, copper, and bismuth.
BRONZE	Tin and copper.
CANNON-METAL	Tin and copper.
DUTCH GOLD	Copper and zinc.
FUSIBLE METAL	Bismuth, lead, and tin.
GERMAN SILVER	Copper, nickel, and zinc, with sometimes a little iron and tin.
GOLD (*standard*)	Gold with copper.
„ (*old standard*)	Gold with copper and silver.
GUN-METAL	See cannon-metal.
MOSAIC GOLD	Copper and zinc.
OR-MOLU	„ „
PEWTER (*common*)	Tin and lead.
„ (*best*)	Tin with antimony, bismuth, and copper.
POT-METAL, COCK-METAL	Copper and lead, with sometimes a little zinc.
QUEEN'S METAL	Tin with antimony, bismuth, and copper.
SHOT-METAL	Lead with a little arsenic.
SILVER (*standard*)	Silver and copper.
SOLDER	Tin and lead.
SPECULUM-METAL	Tin, copper, and arsenic.
STEREOTYPE-METAL	Lead, antimony, and bismuth.
TOMBAC, RED TOMBAC	Copper and zinc.
TUTANIA	See Britannia metal.
TYPE-METAL	Lead and antimony.
WHITE COPPER (*Packfong; White Tombac*)	Copper and arsenic.

Alloy which Expands on Cooling. Lead 9 parts, antimony 2 parts, bismuth 1 part. Useful for repairing defects in small castings.

ALL'SPICE. See PIMENTO.

ALLU″VIAL. (-l'ōōv'-yăl). *Syn.* ALLU″VIOUS*; ALLU″VIUS, L.; D'ALLUVION, Fr. In *geology*, applied to partial deposits of mud, sand, gravel, &c., left by rivers and floods upon land not permanently submerged beneath water; in *agriculture*, applied to soils so formed or deposited.

ALLU″VIUM. [L., Eng.] *Syn.* ALLUVION,

Fr.; ANFLÖSSUNG, ANSCHWEMMUNG, Ger. In *geol.* and *agr.*, alluvial deposit or soil. See SOILS, &c.

AL'LYL $(C_3H_5)'$, $= CH_2{=}CH-CH_2$. In *chemistry,* the radicle of a number of compounds containing sulphur, which form the chief constituents of many essential oils, *e. g.* oil of asafœtida, of garlic, of horse-radish, of mustard, of onions, &c. Thus oil of garlic contains allyl sulphide, $(C_3H_5)_2S$, and oil of mustard allyl isothiocyanate, CS-NC_3H_5 (see OIL OF GARLIC and OIL OF MUSTARD). The radicle allyl does not itself exist in the free state.

AL'MOND (ah'-mŭnd). *Syn.* AMYG'DALA (also -US, -UM*), L.; AMANDE, Fr.; MANDEL, Ger., Dut., Dan., Swed. The 'almond-tree' (*amyg'dalus commu'nis.* Linn.; Ph. L., E., and D.; *Amandier,* Fr.†), a tree of the nat. ord. Rosaceæ, indigenous to Persia, Syria, and the north of Africa, but also extensively cultivated in southern Europe. The almond-tree is about the size of the peach-tree, which it much resembles in appearance. It is incapable of ripening its fruit in this country, and is, therefore, only grown here for the sake of its beautiful vernal flowers. There are several varieties, of which the most important are the sweet and the bitter, so named from the flavour of the seed or kernel. These, for the most part, resemble each other in appearance. De Candolle (' Prodromus,' ii, 530) gives five varieties of this species :—A. AMA''RA (*bitter-almond*); A. DUL'CIS (*sweet a.*); A. FRAGILIS (*tender-shelled a.*); A. MACROCAR'PA (*large-fruited a., pista'chio a., sultana a.*); A. PERSICO'ĪDES (*peach a.*).

Almond, Per'sian. The Peach.

AL'MONDS. *Syn.* AMYG'DALÆ, L.; AMANDES, Fr.; MANDELN, Ger. The seed or kernels of the almond-tree. They are met with in commerce, both in the shell (AMYG'DALÆ CUM PUTAM'INE, -ĭn-e, L.), and shelled (AMYGDALÆ, L.). In the retail shops, most commonly in the latter form. Those rancid, broken, or worm-eaten should be rejected.

Almonds, Bitt'er. *Syn.* AMYG'DALÆ AMA''RÆ, L.; AMYGDALA AMARA, Ph. E.; AMANDES AMÈRES, Fr.; BITTERE MANDELN, Ger. A variety imported from Mogador, chiefly characterised by possessing the bitter flavour, and when rubbed with water, the odour of peach-kernels. They are also smaller and thicker than the sweet almond.

Uses, &c. Bitter almonds are used to relieve the flavour of sweet almonds, to clear muddy water, and to flavour confectionery, liqueurs, &c. By pressure, they yield their bland oil (OIL OF ALMONDS; O'LEUM AMYG'DALÆ, L.); the resulting cake (BITTER-A. CAKE; PLACEN'TA A. AMARÆ, L.) is distilled for the volatile oil (ESSENTIAL OIL OF A.; O. A. A., L.), and is afterwards again pressed into cakes (A.-CAKE), and used to fatten pigs, and for other purposes. Bitter almonds are now seldom employed in medicines, although it is said that they have cured 'intermittents' when bark had failed (*Bergius*), and that their emulsion has been found useful in pulmonary and dyspeptic affections, whooping-cough, and asthma; and externally as a lotion in acne. (*Thomson.*) In large quantities they are poisonous, and even in the smallest quantities have been known to produce nettle-rash (*urticaria*) and other unpleasant symptoms (see AMYGDALIN and EMULSIN). They have long been in repute as an antidote to intoxication. The ancient bacchanals chewed them at their orgies, to lessen the effects of wine, and to enable them to take it in larger quantities with impunity.

Almonds, Blanched' (blăncht'-). *Syn.* AMYG'DALÆ DECORTICA'TÆ, L. Almonds from which the husk or seed-coat has been removed. This is effected by soaking them for a short time in warm water, until the skin can be easily removed by pressure between the thumb and forefinger. They are then peeled, rinsed in cold water, drained, and dried. When intended for the table the last is effected by wiping them with a soft towel; but when they are intended to be powdered, or kept, they are dried by a very gentle heat in a stove, or in the sun.

Almonds, Burnt'. *Syn.* ROASTED ALMONDS; ALMOND COFFEE. Used to colour and flavour liqueurs and confectionery; and formerly, as a substitute for coffee.

Almonds, Cudda Pah. The kernels of *Buchania latifolia,* Roxb. They resemble pistachio nuts, and are largely used in Indian native sweetmeats; an oil is extracted from them. The fruit has a sweetish acid flavour, and is eaten by the hill tribes in the central provinces. The bark is used for tanning.

Almonds, Guia'na. (*gh*e-ā*h*-nă) *g* hard. Brazil-nuts.

Al'monds, In'dian. The fruit of *Terminalia catappa,* Linn. They are oleaginous, and nutritious; and are used as a substitute for almonds.

Almonds, Ja'va (jā*h*'-). The nuts or kernels of *Canarium commune,* Linn. They are eaten, made into bread, and pressed for their oil.

Almonds, Sweet'. *Syn.* ALMONDS; AMYG'DALÆ, L,; A. DULCES, Ph. D.; AMYGDALA, A. JORDAN'ICA, Ph. L.; A. DULCIS, Ph. E., & Ph. L. 1836; AMANDES, AMANDES DOUCES, Fr.; SÜSSE MANDELN, Ger. These are the well-known dessert or table fruit of the name, and are the kind always referred to when 'almonds' (simply) are spoken of or ordered.

Comm. Var. 1. JOR'DAN ALMONDS, which are the finest, and are imported from Malaga. Of these there are two kinds; the one, above an inch in length, flat, and with a clear brown cuticle, sweet, mucilaginous, and rather tough; the other more plump, and pointed at one end, brittle, but equally sweet with the former. 2. VALEN'TIA A. (which come next in quality) are about ⅗ths of an inch broad, not quite an inch long, round at one end, and obtusely pointed at the other, flat, of a dingy brown colour, with a dusty cuticle. 3. BAR'BARY and ITA'LIAN A., which resemble the latter, but are generally smaller and less flattened. 4. A variety, of medium quality, imported in baskets from Spain.

Uses, &c. Sweet almonds are nutritive, emollient, and demulcent; but frequently disagree with weak stomachs. The husk is apt to occasion indigestion and nausea. Owing to a peculiar idiosyncrasy of some habits, dyspepsia, diarrhœa, œdematous swelling of the face, and urticaria

(*nettle-rash*), sometimes, though seldom, follow the use of unblanched almonds. Blanched almonds do not produce these inconveniences, and therefore should be preferred for the table. In *medicine*, almonds are employed chiefly under the form of emulsion, confection, &c., and to suspend oily substances in water. Their uses for dietetical purposes are well known. Preparations of them are also employed as cosmetics. The cake left after expressing the oil (ALMOND-CAKE) is used for washing the skin, which it is said to render beautifully soft and clear. See ALMOND PASTE, &c.

Almonds, Wild. Fruits of *Brabejum stellatum*, Thb., a native of South Africa, where the seeds are eaten raw, and when roasted and ground used as a substitute for coffee.

AL'OE (ăl'-o). *Syn.* AL'OE (-o-e), L., Fr. (or ALOÈS), Ger., Ital., Sp., Belg., Dan., Dut., Swed. The aloe-tree. In *botany*, a genus of plants of the nat. ord. Liliaceæ (DC). The species, of which there are several, are succulent plants or small trees with endogenous stems, and stiff, fleshy, hard, pointed leaves, abounding in a purgative principle (ALOES), which is obtained from them by either evaporating the expressed juice or the decoction. They are all natives of warm climates, and most of them are indigenous to southern Africa.

Hist. *Aehleem* (aloe-trees), were known to the sacred historians; and both the plant and the inspissated juice are described by Dioscorides (Lib. iii, c. xxv) and Pliny ('Hist. Nat.,' lib. xxvii, c. v).

Uses, &c. In Africa, the leaves of the Guinea aloe are made into ropes, fishing-lines, bow-strings, stockings, hammocks, &c. The leaves of another species are used to catch and hold rain-water. The expressed juice and decoction are also used by the natives as a distaff. (Vide *infra.*) Comparative trials, made in Paris, of the strength of cordage and cables formed of hemp, and of the aloe from Algiers, are said to have shown the great superiority of the latter. Fabroni obtained a fine violet colour from the recent juice of the aloe, which has been proposed as a dye for silk. ('Annales de Chimie,' xxv, 305.)

Aloe, American. The *Agave americana*, Linn. is a plant unconnected with the preceding, and belonging to the nat. ord. Bromeliaceæ. It is found in all parts of tropical America, and is largely cultivated on the shores of the Mediterranean; and less frequently, as an exotic plant in this country. It grows to the height of about 20 feet, and takes many years to produce its gigantic and magnificent pyramid of flowers; shortly after which it perishes, exhausted, as it were, by its efforts in bestowing its rare beauty on the floral world. The vulgar belief is that it blossoms only once in a century; but, as stated by the late Mr Loudon, it flowers sooner or later according to the culture bestowed on it. Its sap yields a kind of honey (AGAVE HONEY), and by fermentation an intoxicating liquor (PULQUE); the desiccated juice, mixed with wood ashes, is used as soap, and lathers either with sea or fresh water; leaf-fibre, used as hemp to make thread and twine.

AL'OE-RESIN. *Syn.* RESI'NA AL'OËS, L. The resinous matter deposited by a decoction of aloes as it cools.

Prep. (Ph. L. 1746.) Boil aloes, 1 part, in water, 8 parts, and allow the decoction, strained whilst hot, to repose until the next day; then wash the deposited RESIN, and dry it by a gentle heat. It is probably a mixture of aloin and oxidised extractive.

AL'OES (-ōze). *Syn.* BITT'ER ALOES‡; AL'OË (-o-ē), L.; ALOÈS, SUC D'ALOÈS, Fr.; ALOE, GLAUSINDE ALOE, Ger. (Also see ALOE *above.*) The inspissated juice or extract of several species of aloe.

Comp., Prep., &c. Aloes is a complex resinous substance containing a body called aloin, which is its active or purgative principle. It is completely soluble in boiling water, and in alcohol or rectified spirit. The decoction deposits an impure resin or resinoid on cooling.

Phys. Eff., Uses, &c. Aloes is a tonic stimulating purgative, in doses of 3 to 6 gr.; whilst even 1 or 2 gr. seldom fail to produce one motion without pain or inconvenience. It is considered highly serviceable in hypochondriacal, hysterical, and dyspeptic affections, particulary in phlegmatic habits, and in cases arising from deficiency of bile. As an emmenagogue, and a vermifuge, few medicines are more valuable. It acts on the large intestines, and principally on the rectum; and therefore should be administered with caution, or only in small doses, where there is a tendency to prolapsus or piles, and in cases where uterine stimulants (as in pregnancy, &c.) would be improper. "It is remarkable with regard to it, that it operates almost to as good a purpose in a small as in a large dose; and one or two grains will produce one considerable dejection, and twenty grains will do no more, except it be that in the last dose (case) the operation will be attended with griping, &c. It is one of the best cures for habitual costiveness." (*Cullen.*) Many of the effects complained of arise from its slow solubility in the primæ viæ, and may be obviated by administering it in a liquid form, or in a solid form combined with soap, which renders it freely soluble in the juices of the stomach.

Aloes is more frequently taken than, perhaps, any known purgative. It enters into the composition of a majority of the aperient medicines prescribed by the Faculty, and forms the principal ingredient of nearly all the advertised purgative, antibilious, and universal pills of the nostrum-mongers. The fact of aloetic pills not acting until about 8 to 10 hours after being swallowed—so that if taken on retiring to rest at night they do not generally disturb the patient before the usual time of rising in the morning—has contributed more than anything else to make such remedies popular with parties whose habits or business avocations would be otherwise interfered with.

Aloes is also extensively used in veterinary practice. It is the most valuable and reliable purgative for the horse of the whole materia medica; but is less to be depended on for cattle, sheep, and hogs. Barbadoes aloes is the best for this purpose. Cape aloes is, however, often employed, when 1-4th more must be given.—*Dose* (of the former), for a HORSE, 4 to 8 dr.;—CATTLE, 3 to 6 dr. (followed by a purging drench);—HOGS, 5 to 15 gr.;—SHEEP, 15 to 30 gr.;—DOGS (small ones), 10 to 30 gr. (middle-sized) 20 to 44, or even 60 gr., (large) $\frac{3}{4}$ to 1 dr., or even 2 dr.

Aloes is also used in dyeing; and as a colouring

matter in stains, lacquers, and varnishes. Aloes, and several of its preparations, are employed to adulterate porter.

Var. These, arranged in the order of their reputed medicinal value, are—Socotrine, Hepatic, Barbadoes, Cape, &c.; and alphabetically, as given below:

Aloes, Barba'does. *Syn.* ALOES IN GOURDS; AL'OË BARBADEN'SIS, L., Ph. Brit. Imported from Barbadoes and Jamaica, usually in gourds; sometimes in boxes. The best is the inspissated juice of the cut leaf of *Aloë vulga''ris;* an inferior quality is prepared from the decoction.—*Char., &c.* Opaque, lustreless, of a liver colour, a little tending to black, with a bitter nauseous taste, and a very disagreeable odour, especially when breathed on; powder a dull olive-yellow. It is the 'hepatic' aloes of most continental writers, and said to be the 'Αλόη of Dioscorides. It is more active than the other varieties of aloes; but is also more apt to occasion hæmorrhoids, and to gripe, than any of them.

Aloes, Cab'alline (-līne). *Syn.* FŒT'ID ALOES, HORSE A.; ALOË CABALLI'NA, A. GUINIEN'SIS, L.; ALOÈS CABALLIN, Fr. From *Aloë In'dica* (*O'Shaughnessy*); or from *Aloë spica'ta* by long and careful boiling. (*Lindley.*) Used only by farriers. Scarcely known in English commerce.

Aloes, Cape. *Syn.* ALOË CAPEN'SIS, A. LU'CIDA (*Geiger*), L. Imported from the Cape of Good Hope, and obtained from *Aloë spica'ta,* and other Cape species. Odour stronger and even more disagreeable than that of Barbadoes aloes; colour deep greenish-brown; appearance shining and resinous; fracture generally glassy; powder a lively greenish-yellow; almost completely soluble in boiling water, decoction paler than that of other kinds. It is weaker than Barbadoes or even hepatic aloes, and is more apt to gripe, &c., than the latter. A finer kind, known as '*Bethelsdorp aloes,*' imported from Algoa Bay, is more of a liver colour, and softer than the preceding, and hence often called CAPE HEPATIC-ALOES.

Aloes, Hepat'ic. *Syn.* BOMBAY' ALOES*, EAST-INDIA A.*, LIVER-COLOURED SOCOTRINE A.*; ALOË HEPAT'ICA, Ph. L. & D.; A. IN'DICA, Ph. E. Imported from Bombay and Madras. It is usually said to be obtained from "uncertain species of aloes;" but it is almost certain that it is "the juice of the Socotrine aloes plant which has been solidified without the aid of artificial heat" (Pereira, 'Elem. Mat. Med. and Therap.,' vol. ii, 188, 4th ed.; 'Pharm. Journ.,' vol. xi).—*Char., &c.* "Opaque, of a liver colour, bitter taste, and an unpleasant odour." (Ph. L.) It is less odorous, darker coloured, and more opaque than Socotrine aloes; its powder has also a duller colour, and weak spirit leaves much undissolved matter. Its decoction on cooling frequently deposits a yellow powder. The finer and brighter varieties of hepatic aloes are commonly sold for 'Socotrines,' and their medicinal virtues are nearly similar. (See *below.*)

Aloes, In'dian (various):—1. Deep brown or black, very opaque, and less soluble than ordinary aloes. Scarcely known in commerce.—2. Several varieties ranging in character from 'Cape aloes' to 'hepatics,' and occasionally to 'Barbadoes,' obtained from several species.

Aloes, Mo'cha (-kăh). *Syn.* ALOË DE MOCHÂ, L. Imported from Muscat. An inferior kind of Indian aloes. (*Christison.*) It is obtained from the same plant as produces genuine hepatic aloes. (*Lindley.*) It holds an intermediate position between 'Cape' and 'hepatics,' but contains much impurity; the latter often amounting to upwards of 25%. Some specimens are, however, of excellent quality. When melted and 'doctored,' it is sold for Barbadoes, hepatic, and even Socotrine aloes.

Aloes, Soc'otrine (-trĭn; sŭk'-‡). *Syn.* SOC'-OTORINE ALOES, SMYR'NA A., TUR'KEY A., BOMBAY A., E. INDIAN A., ZANZIBAR, A.; ALOË SOCOTRI'NA, Ph. B.; ALOË, Ph. L., 1836; A. SOCOTORI'NA, Ph. E. "The juice of the cut leaf of various species hardened by the air." Genuine Socotrine aloes is generally supposed to be obtained from *Alöe Perryi;* but is referred by De Candolle to a distinct species, *A. Socotri'na;* and by Martius, also to *A. purpuras'cens.* Formerly this variety was brought from the Island of Socotra or Zocotora (hence the name), by way of Smyrna and Malta; but it is now chiefly obtained from Bombay and Zanzibar.—*Char., &c.* Colour garnet-red to golden-red; smell peculiar and aromatic, not unlike a decaying russet apple, especially when fresh-broken, or breathed on, or warmed; taste permanently and intensely bitter; fracture smooth and resinous; softens in the hand, and becomes adhesive, yet retains considerable brittleness; powder bright golden-yellow colour; central portions of the lumps often soft, especially when first imported. "It is brittle, bitter, of a reddish-brown colour, and an aromatic odour. Light permeates thin recently broken laminæ." "In thin pieces, translucent and garnet red; almost entirely soluble in proof spirit."

Socotrine aloes are always preferred for medicinal purposes, and are the only variety used in perfumery, varnishes, and other nice purposes in the arts.

Aloes, Strained. *Syn.* MELTED ALOES; ALOË COLA'TA, L. *Proc.* 1. The aloes are melted in a copper pan, by the heat of steam or a water-bath, and are then pressed through a strong hair or wire sieve, and allowed to cool.

2. As above, but with the addition of about twice its weight of water; the decoction being strained and evaporated.

Obs. Mocha, Indian, and other common aloes, treated in this way and coloured, are frequently sold for melted or strained 'Socotrines' and 'hepatics.' The colouring matter usually employed is the precipitated carbonate of iron (sesquioxide), or Venetian red, in very fine powder with, sometimes, a little annatto. This fraud is not readily detected by mere inspection, by those unaccustomed to these matters; and hence the impunity with which it is perpetrated.

The object in melting aloes is to deprive it of the foreign matters, as sand, leaves, pieces of wood, &c., which the commoner kinds generally contain in large quantities. The action of the heat drives off much of their nauseous smell, at the same time that it deepens their colour, and renders their appearance more translucent and resinous, to the disguise of their original nature.

The operation, on the large scale, is usually carried on at night, in consequence of the horribly nauseous fumes evolved, which may be smelt at a great distance, and contaminate the clothes of those engaged in it for a long time afterwards.

AL'OES HEMP. A plant growing in Peru, the East and West Indies, and Mexico (*A. americana, A. vivapara, A. fœtida, &c.*), where the leaf is cultivated for its fibre, which is generally of a yellowish-white colour, and used for rope-making.

AL'OES WOOD. *Syn.* AL'OE-WOOD; EAGLE-WOOD; AGAL'LOCHUM (-kŭm), LIG'NUM AL'OËS, L. AGAL'LOCHI, L. A. VE''RI, L. AQ'UILÆ, L. AS-PAL'ATHI, L.; AGALLOCHE, BOIS D'ALOÈS, Fr.; ALOEHOLZ, Ger.; CALAM'BAC, CALAM'BOUC, Ind.; XYLO-AL'OËS†. A name applied to the wood of *Alŏex'ylon agal'lochum*, Lam., a leguminous tree of Cochin China; and to that of *Aquillaria agallocha*, Roxb., and *A. ova'ta*, Lour., trees of tropical Asia, belonging to a different Nat. Order. Called KAYUGARU by the Malays, and AKYAW by the Burmese. Both are highly fragrant and aromatic; used in fumigations and pastilles, and occasionally by cabinet makers and in-layers. The essential oil of the wood, dissolved in spirit, was regarded by Hoffmann as one of the best cordials and invigorants known. The same has also been said of a tincture of its resin.

The same name and synonyms are popularly applied to the resin of the above woods (ALOES-WOOD RESIN), of which there are two varieties: the one, light and porous, and filled with a highly fragrant resinous substance; the other, denser and less resinous. It is an oily concretion in the centre of the tree, the result of disease, which gradually hardens, and, in time, kills it. It is highly fragrant, and is said to be nervine, cephalic, cardiac, and stimulant. The powder is regarded as tonic and astringent. Of all perfumes this is said to be the one most esteemed by oriental nations.

ALOE'TIC. *Syn.* ALOËT'ICUS, L.; ALOÉTIQUE, Fr. Of or belonging to aloes. In *medicine, pharmacy*, &c., applied to any preparation containing aloes as a characteristic ingredient; made or obtained from aloes. Substantively, an aloetic medicine.

ALOE TREE. ALOE DICHOTOMA, L. A native of Namaqualand, S. W. Tropical Africa.

AL'OIN (-o-ĭn). $C_{16}H_{18}O_7$. [Eng., Fr.] *Syn.* AL'ÖIN; ALOÏ'NA, L. The Messrs T. & H. Smith, of Edinburgh, have applied this name to a crystalline substance, which they assert to be the pure cathartic principle of aloes. Their process is to evaporate to the consistence of a syrup, in vacuo, a solution obtained by exhausting a mixture of aloes and sand, with cold water, and then to set it aside for a few days. The resulting dark crystalline mass is purified by pressure between folds of bibulous paper, and repeated crystallisation from hot water. Barbadoes aloes are commonly used for the purpose; but soft or semi-liquid Socotrine aloes, or the unevaporated Socotrine-aloes juice, is probably its best source. Tilden gives the following process for the preparation of aloin:—The aloes crushed small is to be dissolved in nine or ten times its weight of boiling water acidified with sulphuric acid. After cooling and standing for a few hours, the clear liquid is decanted from the resin, and evaporated. The concentrated solution deposits a mass of yellow crystals, which can be purified by washing, pressure, and recrystallisation from hot spirit. After several recrystallisations the aloin is obtained in the form of beautiful yellow needles, which are pretty soluble in water and in alcohol, but soluble with difficulty in ether.—*Dose*, 1 to 2 gr.

Characters.—Usually in tufts of acicular crystals, yellow, inodorous, having the taste of aloes. Sparingly soluble in cold water, freely soluble in hot. Insoluble in ether. Not readily altered by acidified or neutral solutions; rapidly altered in alkaline fluids (B. P.).

ALOPE'CIA (-sh'ă). [L.] *Syn.* AL'OPECY, FOX'-EVIL; ALOPÉCIE, Fr.; FUCHSRAUDE, Ger. In *pathology*, baldness from disease, often extending to the beard and eyebrows; as distinguished from 'calvities,' or ordinary baldness arising from attenuation of the scalp or defective nutrition. See BALDNESS.

ALPAC'A. A species of Llama, popularly known as the PERUVIAN SHEEP, an animal intermediate between the camel and sheep, having long silky hair, nearly as fine as that of the Cashmere goat. It was introduced to the British manufacturers in 1834, when only 5700 lbs. of it was imported; but it soon became an important article of commerce, the quantity imported having gradually risen to above $2\frac{1}{4}$ millions of lbs. in 1853; whilst the price has risen from about 9d. to 2s. 7d. the lb. in the same time. The name is also given to fabrics woven from the wool of this animal; and to others in fine wool, made in imitation of them. The gigantic factory, &c., erected at Saltaire, Yorkshire, in 1852, for this manufacture, covers about 12 acres of land. See LLAMA.

ALPENKRAUTER - BRUST - TEIG. (*Grablowitz*, Gras). Pectoral cakes of Alpine herbs. Gum arabic, 100 parts; sugar, 200 parts; extract liquorice, 1 part; saffron, $\frac{1}{8}$th part. Each box contains 48 lozenge-shaped yellowish cakes. Made into a mass with decoction of marsh mallow. (*Hager.*)

ALPENKRAUTER GESUNDHEIT'S LIQUEUR (*Rudolph Bohl*). Medicinal liqueur of Alpine herbs. A bottle containing 350 grms. of a liqueur which is an extract of star anise, cassia, frangula bark, centaury, chicory, gentian, and a little aloes. (*Hager.*)

ALPENKRAUTER - MAGENBITTER. (*Hauber*). Stomachic bitters of Alpine herbs. A brown liqueur of bitter, spirituous, and slightly aromatic flavour, containing, in 100 parts: oil of anise, 0·5; oil of cloves, 0·5; aloes, 1·5; alcohol, 40; water, 50. 157 grammes in each bottle. (*Wittstein.*)

ALPHA-ORSELL'IC ACID. See ORSELLIC ACID.

ALPINE ROSE SOAP, SWISS. A preservative against syphilitic infection (*G. A. Sarpe*, Zurich). A glass cylinder corked and sealed, about 2 inches long, and containing a hard, brownish-grey mass, weighing 12 grms. prepared thus:—Ammonia, 1 part; sublimate, 3 parts; tannin, 2 parts; chloride of lime, 24 parts; Castile soap, 190 parts; oil of cloves, 1 part; spirit of wine, q. s. (*Hager.*)

AL'QUIFOU (-ke-fōō). *Syn.* Black lead-ore, Potter's ore. A native sulphide of lead used by potters to give a green glaze to coarse wares.

ALISMA PLANTAGO, or **WATER PLANTAIN.** The use of the root of this plant as a remedy for hydrophobia is by no means recent, and was sanctioned by the College of Physicians of Moscow in the year 1820. Its value is, however, very doubtful. The root contains a very active principle. Cattle are frequently poisoned by it, and it is held in repute in some parts of America as a remedy for the bite of the rattlesnake. It has powerful sedative properties, and is best administered by scraping about an ounce of the solid root and letting it be eaten between two slices of bread. (*Christy.*)

ALSTONIA CONSTRICTA. Antiperiodic, antiseptic, and nerve stimulant, combining the properties of quinine and strychnine. Used in typhoid, synochal, and puerperal fevers. Used by brewers of pale ale for export, as it produces neither headache nor the other ill effects of hops. Doses of the powdered bark, 5 gr.; in colds, 2 gr. every two hours; the tincture (2 oz. to 1 pint of proof spirit) ½ dr. to 2 dr.

Alstonia constricta is known as Queensland fever bark, and is there held in high estimation as a febrifuge, and is said to frequently produce a good effect in cases in which quinine has failed, especially in chronic cases.

ALSTONIA SCHOLARIS, DITA BARK. (Ind. Ph.) *Habitat.* Common in forests throughout India.— *Officinal Part.* The bark (*Alstoniæ cortex*). It occurs in thick, irregular, more or less contorted pieces, easily broken. It consists of a rough greyish epidermis, investing a buff or pale cinnamon-coloured bark; internally, still lighter in colour, and of a spongy texture, having a very bitter taste, but devoid of odour.

Dr O. Hesse reports that the bark contains three alkaloids, viz. ditamine, echitamine, echitinine.

Properties. Astringent, tonic, anthelmintic, antiperiodic.—*Therapeutic Uses.* In chronic diarrhœa and the advanced stages of dysentery; also as a tonic in debility after fevers, and other exhausting diseases.—*Dose,* 3 to 5 gr., either alone or combined, in bowel affections, with small doses of ipecacuanha and extract of gentian.—*Preparations.* Tincture of Alstonia (*Tinctura Alstoniæ*). Take of alstonia bark, bruised, 2½ oz.; proof spirit, 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; filter, and add sufficient proof spirit to make 1 pint. Or, prepare by percolation, as Tincture of Calumba.—*Dose,* 1 to 2 fl. dr.

Alstonia, Infusion of. (*Infusum Alstoniæ.*) Take of alstonia bark, bruised, ½ an oz.; boiling water, 10 fl. oz. Infuse in a covered vessel for an hour and strain.—*Dose.* From 1 to 2 fl. oz., twice or thrice daily. A good serviceable tonic.

AL'TERATIVE (awl'-tĕr-ă-tĭv). *Syn.* Al'terant*; Al'terans (ăl'-), L.; Altérant, Altératif, Fr. In *medicine,* having power to alter; applied to substances and agents which occasion a change in the habit or constitution, and thus re-establish the healthy functions of the body, or any part of it, without producing any sensible evacuation or other obvious effect. Alteratives seem to exert their action upon assimilation and tissue change.

AL'TERATIVES (-tĭvz). *Syn.* Alteran'tia, L.; Altératifs, &c., Fr. Alterative medicines or agents.

The principal alteratives are nitric and nitrohydrochloric acids, chlorine and chlorides, iodine and iodides, sulphur and sulphides, potash and its salts, mercury and its salts, phosphorus, hypophosphites, antimony, arsenic, taraxacum, sarsaparilla, hemidesmus, guaiacum, mezereon, and dulcamara.

ALTERATIVE EXTRACT, or **GOLDEN MEDICAL DISCOVERY** (*Dr Pierce,* Buffalo), for the cure of all severe, acute, chronic, or long-standing coughs, inflammations, hoarseness, scrofulous, and syphilitic diseases. A clear, light brown fluid, 220 grms., composed of 15 grms. purified honey, 1 grm. extract of lettuce, 2 grms. laudanum, 100 grms. of proof spirit tasting of fusel oil and wood spirit, and 105 grms. water. (*Hager.*)

ALTHOFF WATER (Aqua Mirabilis), for torpid ulcers. Wine vinegar, 750 parts; sulphate of copper, 100 parts; potash, 25 parts; ammonia, 30 parts; salt of sorrel, 8 parts; French brandy, 375 parts. Digest for a few days in a glass vessel and distil to dryness from a glass retort. (*Wittstein.*)

AL'UDEL (-ū-). From the Arabic *al-uthal.* In *chemistry,* a pear-shaped glass or earthen pot open at both ends, formerly much used for connecting other vessels in the process of sublimation. A number of them joined together are still employed for the distillation of quicksilver, in Spain.

AL'UM. $K_2SO_4.Al_2(SO_4)_3.24Aq$. *Syn.* Pot'ash-alum, Sul'phate of aluminium and potassium, Common alum; Alu'men, A. potas'sicum, L.; Alun, Sulfate d'alumine et de potasse, Fr.; Alaun, Ger.; Alume, Ital.

The principal alum works in England, until recently, were those of Lord Glasgow, at Hurlett and Campsie, near Glasgow, and those of Lords Dundas and Mulgrave, at Whitby, Yorkshire (est. 1600); but those of Mr Spence, at Manchester, and at Goole (Yorkshire), and of Mr Pochin, at Manchester, are now among the largest, if they are not actually the largest in the world. There are also extensive alum works at and near Newcastle-on-Tyne; but none of importance, that we know of, in any other part of these realms.

Nat. Hist. Alum is found native in some places (native alum), either effloresced on the surface of bituminous alum-schist (Göttwigg, Austria), or united with the soil in the neighbourhood of volcanoes (Solfatara, Naples); when it may be obtained by simple lixiviation and evaporation, a little potash being commonly added to convert the excess of sulphate of alumina present into alum. It is also found in certain mineral waters (East Indies).

Sources. The alum of commerce is usually obtained from schistose pyritic clays, commonly termed alum ores, aluminous shale, aluminous schist, &c.; and from alum-rock, alum-stone, or alunite. At La Tolfa, Civita Vecchia, where the best Roman alum is produced, the source is stratified alum-stone. On the Continent, and in Great Britain, it is generally pyritaceous clays,

volcanic aluminous ores, aluminous shale, or alum-slate. These minerals contain iron pyrites, alumina, bitumen or carbon, and frequently a salt of potassium. Of late years large quantities of alum have been prepared on the banks of the Tyne from aluminous clay.

Prep. The manufacture of alum is technically said to be conducted according to the natural process, when it is prepared from alum-schist or alum ore; and according to the artificial process, when it is made by acting on clay with sulphuric acid, and adding a potassium salt to the resulting lixivium. The manufacture of alum and of sulphate of alumina from such materials as contain only alumina, to which consequently sulphuric acid and alkaline salts have to be added, has come largely into practice in England. The materials employed are, in addition to clay, cryolite or Greenland spar, a fluoride of aluminum and sodium; bauxite, a hydrate of alumina, of more or less purity; and slag.

The alums are double salts of aluminium sulphate, $Al_23(SO_4)$, with potassium or ammonium sulphate, and have the composition Al_23SO_4, $K_2SO_4 + 24H_2O$ and Al_23SO_4, $(NH_4)_2SO_4 + 24H_2O$ respectively. Two methods are chiefly adopted for the preparation of the alums. In the first, an earth rich in alumina is dissolved direct in sulphuric acid and so converted into aluminium sulphate; in the second, an aluminous shale containing iron pyrites is chosen, and the atmospheric oxidation of the pyrites allowed to take place, the change being assisted by heating if necessary. Under these circumstances ferrous sulphate and free sulphuric acid are formed, and react on the alumina contained in the ore, forming aluminium sulphate. To the aluminium sulphate prepared by either of these methods, potassium or ammonium sulphate or chloride is added. The sole object of adding these salts to the aluminium sulphate is to enable the latter to crystallise, and so to facilitate its separation from the iron salts and other impurities which the crude solution contains.

The greater portion of the alum in this country is manufactured from alum shale, a bituminous shale containing pyrites, and occurring near Whitby in England, and at Hurlett and Campsie, near Glasgow, in Scotland. The ratio of alumina to pyrites varies considerably in different ores, and it is found advantageous to mix these so that the sulphuric acid produced by the oxidation of the pyrites may be equivalent to the alumina in the ore. The following analyses will give an idea of the usual composition of alum ores.

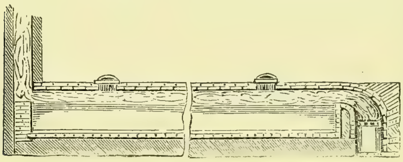
	Whitby, Yorkshire, (*Richardson.*)	
	Top rock.	Bottom rock.
Bisulphide of iron (*pyrites*)	4·20	8·50
Silica	52·25	15·16
Protoxide of iron	8·49	6·11
Alumina	18·75	18·30
Lime	1·25	2·15
Magnesia	·91	·90
Oxide of manganese	traces	traces
Sulphuric anhydride (SO_3)	1·37	2·50
Potash	·13	traces
Soda	·20	traces
Chlorine	traces	traces
Coal	4·97	8·29
Water	2·88	2·00
Loss	4·60	(?)
	100·	100·

	Campsie, near Glasgow. (*Ronalds.*)		
	Top rock.	Top rock.	Bottom rock.
Bisulphide of iron (*pyrites*)	40·52	38·48	9·63(?)
Silica	15·40	15·41	20·47(?)
Protoxide of iron	...	...	2·18
Alumina	11·35	11·64	18·91 (?)
Lime	1·40	2·22	·40
Magnesia	·50	·32	2·17
Oxide of manganese	·15	...	·55
Sulphuric anhydride	...	...	·05
Potash	·90	...	1·26
Soda	...	...	·21
Carbon or bituminous matter	27·65(?)	28·80	(?)
Coal	...	...	8·51
Water	...	...	8·54
Loss	2·13(?)	3·13	1·59(?)
	100·	100·	100·

The pyrites occurs in the shale in two forms, partly in yellow crystals and partly as a dull black powder. The latter is the more rapidly oxidised on exposure to the air.

Processes. a. From BITUMINOUS SHALE. In order to oxidise the pyrites, the ore is broken into pieces and laid upon a bed of brush-wood and small coal, to the depth of about four feet, when the pile is fired, and fresh lumps of the alum mineral are thrown on until the mass becomes of considerable height and size. The combustion, as soon as established, is conducted with a smothered fire, until the calcination is complete; care being taken to prevent fusion, or the disengagement of either sulphurous or sulphuric acid, from contact between the ignited stones and the carbonaceous fuel. [The generality of alum minerals require roasting; and their own bituminous matter is, in many cases, sufficient to produce the temperature required, which need not necessarily exceed 315°—344° C. (600°—650° F.), provided it be continued for a sufficient period. It is only when they are less bituminous or carbonaceous that slack or sawdust, &c., is employed.] To promote these ends the pile,

at the proper time, is 'mantled' (as the workmen call it) or covered with a layer of already calcined and exhausted ore, in order to protect it from high winds and heavy rains, and also to moderate the heat, and let the oxidation proceed gradually, so that the sulphur present may not be lost or wasted by volatilisation. The roasting is finally checked by a thicker 'mantling,' and the whole allowed to cool. By this time the pile has usually lost about one half its bulk, and become open and porous in the interior, so that the air can circulate freely through the mass; the latter, in dry weather, as the heap cools, being also usually promoted by sprinkling a little water on it, which, by carrying down some of the saline matter, renders the interior still more open to the atmosphere. The whole, when cold or nearly cold is, if necessary, still further exposed to the action of air and moisture. The time required to calcine the heap properly, including that taken by the burned ore to cool, varies, according to its size and the state of the weather, from three to nine, or even twelve months. The residuum of the calcination is next

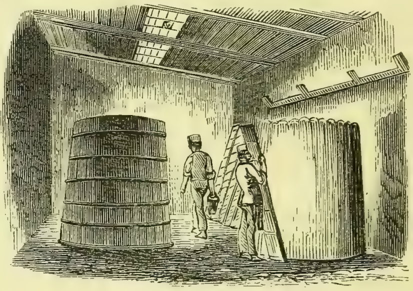


placed in large stone or brick cisterns, and treated with water, until all the soluble portion is dissolved out; the solution is then concentrated in another stone cistern, so made that the flame and heated air of its reverberatory furnace sweep the whole surface of the liquor. (See *engr.*) The evaporation is continued until it just barely reaches the point at which crystals are deposited on cooling, when it is run off into coolers. After the sulphate of iron, which is always present, has been deposited in crystals, the mother-liquor, containing the sulphate of aluminium, is run into other cisterns, and a saturated solution of chloride of potassium, or of sulphate of potassium, or (sometimes) impure sulphate or carbonate of ammonium, or a mixture of them, is added until a cloud or milkiness ceases to be produced on the addition of more. [For pure POTASH-ALUM, a salt of potash only must be employed. When ammonia (usually in the form of gas-liquor or gas-sulphate) is used as the precipitant, the product is AMMONIA-ALUM. The ordinary alums of commerce are now generally mixtures of the two. The respective quantities required to produce 100 parts of alum from the sulphate of alumina liquor are—

Chloride of potassium . .	15·7 parts.
Sulphate of potassium . .	18·4 ,,
Sulphate of ammonium . .	13·9 ,,

In practice, the exact quantity required may be found by a previous trial of a little of the aluminous liquor; but the indications mentioned in the text will always show the operator when a sufficient amount has been added.]

It is next allowed to settle and get thoroughly cold, and the supernatant 'mother-liquor' being drawn off with a pump or syphon, the precipitate, which is alum in the form of minute crystals (technically termed 'flour'), is well drained, and subsequently washed by stirring it up with a little very cold water, which is then drained off, and the operation repeated a second time with fresh water. A saturated solution of the pulverulent



alum ('flour') is next formed in a leaden boiler, and the clear portion is run or pumped off, while boiling hot, into crystallising vessels, called roaching casks (see *engr.*), the staves of which are lined with lead, and nicely adjusted to each other. After the lapse of a week or ten days the hoops and staves of these 'casks' are removed, when a thick crust of crystallised alum is found, which exactly corresponds in form and size to the interior of the cask. A few holes are then made in the sides of this mass, near the bottom, to allow the contained mother-liquor to drain off, after which the whole is broken up and packed in casks for sale. Sometimes the alum thus obtained, or the lower portion of it, is washed with a little very cold water, and, if discoloured, or small or slimy, is purified by a second crystallisation.

Instead of crystallising out the iron salts first, it is sometimes the practice to add alkaline salts after concentration, and so obtain a crop of the readily crystallisable alum. After this the mother-liquor is concentrated until the iron and magnesium salts crystallise, when a further quantity of alum can be obtained by a second addition of alkaline sulphate or chloride. In recrystallising the various crops the water is used systematically, the mother-liquor from the final crystallisation being used to dissolve the crop coming next in order, and so on. The presence of lime in alum ore is most prejudicial, owing to its affinity for sulphuric acid being greater than that of either alumina or iron. Magnesia is also wasteful, but the magnesium sulphate formed is sometimes recovered.

b. From ALUMINOUS CLAY and OIL OF VITRIOL:

1. Clay, free or nearly free from carbonate of lime and oxide of iron, is chosen for this purpose. It is moderately calcined (in lumps) in a reverberatory furnace, until it becomes friable, great care being taken that the heat be not sufficient to indurate it, which would destroy its subsequent solubility. It is next reduced to powder, sifted, and mixed with about 45% of its weight of sulphuric acid (sp. gr. 1·45), the operation being conducted in a large stone or brick basin arched over with brickwork. Heat is then applied, the flame and hot air of a reverberatory furnace being made

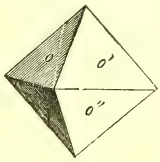
to sweep over the surface of the liquor. The heat and agitation are continued for 2 or 3 days, when the mass is raked out and set aside in a warm place for 6 to 8 weeks, to allow the acid the more perfectly to combine with the clay. At the end of this time the newly-formed sulphate of alumina is washed out, the solution evaporated until a sp. gr. of about 1·38 (1·24 for 'ammonia-alum') is attained, and the salt of potash added. The remaining operations resemble those above described. Good alum may be produced by this process at about two thirds the cost of rock or mine alum.

2. Process of *Mr Pochin.* Fine China clay is heated in a furnace, and mixed with a suitable proportion of sulphuric acid, the latter being considerably diluted with water, in order to moderate its action, which would otherwise be far too violent. The mixture is then passed into cisterns furnished with moveable sides, where, in a few minutes, it heats violently and boils. The thick liquid gradually becomes thicker, until it is converted into a solid porous mass, the pores being produced by the bubbles of steam which are driven through it, owing to the heat resulting from the reaction of the ingredients on each other. This porous mass (ALUM-CAKE or CONCENTRATED ALUM) appears perfectly dry, although retaining a large amount of combined water. It also contains all the silica of the original clay, but in such a state of fine division, that the whole appears homogeneous, whilst the former imparts a dryness to the touch which can scarcely be given to pure sulphate of alumina. From this substance a solution of pure sulphate of alumina is easily obtainable by lixiviating, and allowing the resulting solution to deposit its silica before using it, but for many purposes the presence of the finely divided silica is not objectionable. The sulphate of alumina solution, so obtained, is adapted to all the purposes in dyeing for which alum is now employed, the sulphate of potash or of ammonia in the latter being an unnecessary constituent, and one merely added to facilitate the purification and subsequent crystallisation of the salt. To obtain ALUM from the porous alum-cake, the proper proportion of acid having either been used in its preparation, or subsequently added, it is only necessary to precipitate its concentrated solution with a strong solution of a salt of potash, or of ammonia, or a mixture of them, and otherwise to proceed as before.

c. From chemically-prepared alumina. Alumina is prepared by chemical means from cryolite or bauxite (see ALUMINIUM OXIDE) by dissolving these in sulphuric acid and evaporating to aluminium sulphate, or converting the latter into alum by the addition of potassium or ammonium sulphate.

Prop. Alum crystallises in regular octahedrons, often with truncated edges and angles (see *engr.*). It is soluble in 10 to 11 parts of cold water, and in rather less than its own weight of hot water. Tastes very astringent; is styptic, and reddens litmus.

When heated it melts, loses its water of crystallisation, and becomes white and spongy. At a heat approaching whiteness it decomposes, giving off oxygen, and sulphurous and sulphuric anhydrides. Calcined with carbonaceous matter it forms a spontaneously inflammable mixture, this inflammability being due to the presence of potassium sulphide in a fine state of division.



Ignited with alkaline chlorides, hydrochloric acid is liberated, which also occurs when their concentrated solutions are boiled together. Ammonia precipitates pure hydrate of alumina from potash-alum, but only a sub-sulphate from the simple sulphate of alumina. Sp. gr. 1·724; but, when containing ammonia, often as low as 1·710.

Tests for, &c. It is easily recognised by its crystalline form, taste, &c. Its aqueous solution gives a white precipitate with caustic soda, soluble in excess. Potash-alum, ignited on a platinum wire, colours the flame violet. Ammonia-alum evolves ammonia when mixed with caustic alkali solution or with soda-lime and moistened. With barium chloride a white precipitate, insoluble in hydrochloric acid, is produced. (For *estimation*, see ALUMINIUM, SALTS OF.) When pure, its solution is not altered by tincture of galls, sulphuretted hydrogen, or potassium ferrocyanide; neither does it give any precipitate with silver nitrate.

Adult., &c. The principal impurity, and one which renders alum unfit for the dyer, is iron. This may be detected by the blue colouration or precipitate which it gives with ferrocyanide of potash, or the black precipitate with ammonium sulphide. (Good English alum contains less than 0·1% of iron, while the best Roman or Italian alums seldom contain more than ·005%.) Lime, another very injurious contamination, may be detected by precipitating the alumina and iron (if any) with ammonia, and then adding ammonium oxalate to the boiled and filtered liquid. The liquid filtered from the last precipitate (oxalate of lime) may still contain magnesia, which can be detected by the white precipitate formed on the addition of common sodium phosphate, Na_2HPO_4. Common alum frequently contains ammonia, from urine, or from the crude sulphate of the gas-works employed in its manufacture. Powdered alum is often adulterated with common salt, which may be detected by means of silver nitrate.

Physical Effects. In *therapeutics*, alum is used as an astringent, and in the form of dried or burnt alum (Alumen Exsiccatum, q.v.) it acts to some extent as an escharotic. Taken internally it appears to act in the first instance as a direct astringent upon the mucous membranes of the stomach and intestines; afterwards it is absorbed and produces remote astringent effects upon the various tissues and secreting organs. If taken in large doses it acts as a purgative. Its uses in medicine are very numerous, a solution of alum forms a simple and efficient gargle in cases of relaxed sore-throat, so called; as an injection it is often useful in cases of leucorrhœa, &c.; as a lotion in acute ophthalmia, especially of newborn

children; it is also sometimes used internally in cases of internal hæmorrhages and passive discharges; it has also been given as a purgative in painters' colic, probably having in addition the effect of converting the lead salts in the system into the insoluble sulphate. It has been used to a considerable extent in the treatment of whooping-cough.

Dose. Of alum 10 gr. to 20 gr. as an astringent, alone or in combination with kino, &c.; as a purgative, 20 gr. to 30 gr. may be given. Burnt alum is *for external use only.*

The following are incompatibles:—Alkalies and their carbonates, tannic acid, or infusions and decoctions which contain it; tartrates, salts of lead, barium, and calcium, cause precipitates in solutions of alum. Alum has been detected in the liver, spleen, and urine (*Orfila*), the latter becoming very acid after considerable doses have been taken (*Kraus*). The supposed general use of alum by bakers in order to improve the appearance of their bread, or to enable them to work up batches of unsound flour, is probably somewhat exaggerated. That it is not always introduced into the flour by the bakers, but sometimes by the millers, the following facts will prove. Some years ago, at a mill in Worcestershire, one of the workmen put several shovelfuls of what he supposed was alum into a quantity of flour, with the result that, though the mistake was very quickly discovered and every possible means taken to prevent the sale of this particular sample, some fifty or sixty persons were poisoned, and several died, the material put into the flour being not alum, but white arsenic, intended to be used for the dressing of some seed wheat. The use of alum as an adulterant of flour will be again referred to under BREAD. As to the precise effects of the continual consumption of bread containing alum there has been considerable difference of opinion, probably because no two samples of adulterated bread contain the same proportion, and further, because these effects may be, and probably very often are, due, not so much to the alum as to the bad and unsound flour, the defects of which it has been used to disguise. The ingestion of eight grains of alum per diem (the quantity which used not unfrequently to be found in a pound of bread) is undoubtedly deleterious, and though its properties are not such as to occasion any immediate or strong effect, and its deleterious action cannot be brought home to it in a precise or definite manner, it is believed to be capable of producing dyspepsia and constipation. "Whatever doubts," says Pereira, "may be entertained regarding the ill effects of alum on the healthy stomach, none can exist as to its injurious influence in cases of dyspepsia."

Uses, &c. The applications of alum in the arts and in manufactures are numerous and important. It is used to harden tallow and fats, to render wood and paper incombustible, to remove greasiness from printers' blocks and rollers, to prepare a paper for whitening silver and silvering brass in the cold; and though its use for the purpose is inadvisable, to assist the separation of butter from milk. In the various photo-mechanical processes it is very largely used for the purpose of hardening the gelatin blocks used for printing from; and this property of hardening and coagulating gelatin and albuminous matter renders alum of great service to the taxidermist and fellmonger as a dressing for skins. Perhaps one of the most important applications of alum depends upon this action on animal matter, as it confers on solutions of alum the power of purifying foul water and making it reasonably fit for drinking purposes. It is particularly useful on this account to residents in India and other tropical countries in which the water is stored in tanks, and liable to be constantly fouled by the habit of the natives to use these tanks for washing purposes and for the bathing of cattle. Such water should be treated with alum to the extent of six grains per gallon, and should then be allowed to stand twelve hours before being used in order to allow the sediment to settle. Burnt alum may be used instead of the ordinary form, and as a much smaller weight is required (the water of crystallisation having been removed) travellers can easily carry sufficient to purify a considerable quantity of water. The use of alum in dyeing to form with certain classes of colours insoluble compounds called lakes, and thereby fix the colour on the fabric, will be explained under DYEING.

The potash salt employed by the alum-makers is either the sulphate or chloride, chiefly the latter; its sources being the waste liquor of soap-works, saltpetre refineries, and glass-houses.

The ammonia salt used in making alum is generally the crude sulphate prepared from the ammoniacal liquor of the gas-works, or that from the manufacture of sal ammoniac by the destructive distillation of animal matter. Both these liquors may be used without previous conversion into sulphate of ammonia, whenever there is an excess of sulphuric acid in the aluminous solution. See ALUMS, AMMONIA, DYEING MORDANTS, POTASH, SULPHURIC ACID, &c.; also *below.*

Table showing the Strength of Solutions of Potassium and Ammonium Alum by Specific Gravity at 17·5° C.

Per cent.	$K_2Al_2(SO_4)_4$ + 24 Aq. Density.	$(NH_4)_2Al_2(SO_4)_4$ + 24 Aq. Density.
1	1·0065	1·0060
2	1·0110	1·0109
3	1·0166	1·0156
4	1·0218	1·0200
5	1·0269	1·0255
6	1·0320	1·0305

Alum, Ammonia. $(NH_4)_2SO_4,Al_2(SO_4)_3,24H_2O$. *Syn.* (ALUMEN, ALUM, B.P.) ALUMEN AMMONIA'CUM, L.; ALUM D'AMMONIAQUE, A. AMMONIACAL, Fr. See *above.* Much of the ordinary alum contains ammonia. It is distinguished from potash alum by the ammonia evolved when it is heated with caustic soda or lime, and by the residue of pure alumina which it leaves when ignited.

Alum, Basic. A variety of (potash) alum found native at Tolfa. On gentle calcination the excess of alumina is rendered inactive, and the alum can

then be dissolved out with water. The calcination is carried out in ovens similar to those used for preparing plaster of Paris. Great care is necessary to prevent the temperature from rising too high. It is by this process that Roman alum is prepared.

ALUM-EARTH. Alumina. An earth used in the East Indies by the native doctors has been termed alum-earth. It contains silica, 5·02% ; iron and alumina, 1·60% ; calcic carbonate, 6·22% ; magnesic carbonate, 8·92% ; organic matter and combined water, 78·24%. This is, therefore, not really alum-earth at all, and contains no constituent which could be manufactured into alum. The earth yields on distillation a light oil similar to that found in shale, probably a petroleum. (*Christy.*)

ALUM MOR'DANTS. In *dyeing*, mordants having for their basis either common alum or the acetate or sulphate of aluminium. See ALUMS and MORDANTS.

AL'UM-ROOT. *Syn.* AMER'ICAN SAN'ICLE; HEU'CHERA (Ph. U. S.), L. The root of *Heuchera america'na*, Linn., a plant of North America. It is powerfully styptic and astringent; and is used chiefly as an external application in cancer.

ALUM WHEY. Add a quarter of an ounce of powdered alum to a pint of boiling milk, and strain. An astringent drink. May be flavoured with sugar and nutmeg if desired.

ALUM-WHITE. See WHITE PIGMENTS.

ALUMS. *Syn.* ALU'MINA (pl. of ALU'MEN), L. In *chemistry*, a term applied to a comparatively large class of double sulphates containing an alkali metal and a metal of the iron group, and having the general formula $M_2(SO_4)_3,N_2SO_4,24H_2O$. They all crystallise in forms derived from the octahedron, and can be prepared by mixing solutions of the respective sulphates in molecular proportions, and evaporating to the crystallising point. The only alum of technical importance besides those already considered is CHROME ALUM (which *see*).

Alum, Baumé's. Alum-white. See WHITE PIGMENTS.

Alum, Dried; Alum, Burnt. *Syn.* ALU'MEN US'TUM, A. EXSICCA'TUM (B. P.); ALUN SEC, Fr.; GEBRANNTER ALAUN, Ger.; ALUME CALCINATO, Ital. Alum deprived of its water of crystallisation by heat.

Prep. Take of potassium alum, 4 oz. Heat the alum in a porcelain dish or other suitable vessel, till it liquefies, then raise and continue the heat, not allowing it to exceed 400°, till aqueous vapour ceases to be disengaged, and the salt has lost 47% of its weight. Reduce the residue to powder, and preserve it in a well-stoppered bottle.

Prop., &c. Similar to those of common alum, but it is rather more astringent, and is less soluble. When moistened, or placed in contact with water, it resumes its water of crystallisation with evolution of heat.—*Dose*, 10 to 20 gr.; in colic (especially painters' colic), hæmoptysis, &c. It is chiefly used as an escharotic, to destroy 'proud flesh,' &c. It must be kept in a stoppered bottle.

Alum, Chrome. See ALUMS (in *chemistry*).

Alum, I'ron (-ürn). *Syn.* ALU'MEN, FER'RICUM, SUL'PHAS FER'RI ET POTAS'SÆ, FER'RI PEROX'IDI POTASSIO-SUL'PHAS, &c., L.

Comp. $K_2SO_4.Fe_2(SO_4)_3.24Aq$.

Prep. Take of peroxide of iron, 9 lbs.; sulphuric acid 14 lbs.; dissolve, dilute the mixture with water, q. s., and add of potassium sulphate, 10 lbs.; evaporate, and crystallise.

Prop., &c. Crystals, beautiful octahedrons of a pinkish or pale violet colour. It is strongly recommended, by Dr Tyler Smith, as a chalybeate tonic, and has been used by him, at St Mary's Hospital, with marked success. It has also been used as a mordant, in dyeing black.—*Dose*, ½ gr. to 5 gr.

Alum, Ro'man. *Syn.* RED ALUM*, ROACH A., ROCHE A., ROCK A.*; ALU'MEN ROMA'NUM, A. RU'BRUM, A. RU'PEUM, &c., L.; ALUN ROMAIN, A. DE ROCHE, Fr.; ALUME DI ROCCA, Ital. In small fragments, covered with a reddish powder (ALUMEN RUBRUM VE''RUM); originally imported from Civita Vecchia, where it occurs native. It is much esteemed by dyers from being nearly free from iron-alum. That now sold for it in England is ordinary alum coloured with Venetian red, Armenian bole, or rose-pink (ALUMEN RUBRUM SPU''RIUM). This is done by shaking the fragments in a sieve over a vessel of hot water, and then stirring them up with the colour, until the surface is uniformly tinged with it. In genuine roach-alum the colour not only covers the surface, but also partially pervades the substance of the crystals. The name was formerly also applied to a pure white variety of alum, prepared at Tolfa; but it is now, in English commerce, exclusively given to common alum artificially coloured.

Alum, Saccharated. Alum, 6 oz., white lead 6 dr., sulphate of zinc 3 dr., sugar 1½ oz. Mix the ingredients reduced to powder into a paste, with vinegar and white of egg. Used in eye waters and cosmetic washes.

Alum, So'da. *Syn.* SULPHAS ALUMINÆ ET SODÆ, L. *Comp.* $Na_2SO_4.Al_2(SO_4)_3.24Aq$. An alum in which the potassium sulphate of common alum is replaced by a like salt of sodium. It does not occur in commerce.

ALUMINIUM. [Eng., Fr., L.] This metal, whose oxide is widely disseminated in the form of alumina, Al_2O_3, was first isolated by Wöhler in 1827, by treating aluminium chloride, Al_2Cl_6, with metallic potassium—

$$Al_2Cl_6 + 6K = 6KCl + 2Al.$$

The metal thus obtained as a grey powder was far from pure, containing probably potassium, aluminium chloride, and perhaps a little platinum from the boat in which it was prepared. In 1854, St Claire Deville first obtained it in a state of purity, and studied its properties.

The usual method of isolating metals, viz. by heating their oxides with carbon, has never succeeded with alumina at furnace temperatures; in fact, the heat of formation at moderate temperatures of alumina, Al_2O_3 (388,000 cals.), is greater than that of the equivalent quantity of carbonic oxide, 3CO (87,000 cals.). At high temperatures, however, affinities are frequently reversed, and it has been found possible to reduce alumina by means of carbon at the high temperature of the electric arc (4000°—6000° C.).

Wöhler, in his original process, warmed alu-

minium chloride with an equal bulk of potassium in a platinum crucible until the reaction commenced. This is an extremely violent one, the lid of the crucible being blown off unless weighted down. The metal separates in the form of a fine powder, and can be obtained by treating the mass with water. A good deal of the metal oxidises, however, and what is obtained is extremely difficult to purify. Porcelain vessels cannot be used, as aluminium attacks them, forming silicide of aluminium.

Deville improved upon this process by placing the aluminium chloride and metal (sodium) in separate boats in a porcelain tube filled with hydrogen, and distilling the aluminium chloride into the metal. At the end of the reaction the boats contained aluminium and the double chloride of aluminium and sodium, $Al_2Cl_6,2NaCl$, thus:

$$4Al_2Cl_6 + 6Na = 3[Al_2Cl_6,2NaCl] + 2Al.$$

The contents of the boats were next placed in shallow vessels made of gas carbon which had been ignited in chlorine (to get rid of silica), and strongly heated in a stream of hydrogen. By this means the double chloride of aluminium and sodium was volatilised, and the aluminium left in the form of buttons. It was this process which Deville afterwards carried out on a large scale, and it forms the first manufacturing process for aluminium. The details are much the same. The aluminium chloride was heated in an iron retort and its vapour passed over heated nails (to convert any ferric chloride into the comparatively non-volatile ferrous chloride), and then over sodium contained in iron boats. The reaction is never complete, as the sodium chloride formed covers the sodium and protects it from the aluminium chloride vapour. The contents of the boats were next heated in a crucible and the fused sodium chloride skimmed off. The aluminium should not be melted if there is much excess of sodium, as it is liable to take fire and burn to aluminium oxide. The mass in the crucible, when cold, was treated with water, and the buttons of aluminium collected. Any aluminium which may be in the form of powder is lost, as the aluminium chloride attacks it readily. It will be seen that the points of importance in this process are to avoid a large excess of sodium, and to obtain the metal in as large globules as possible.

Aluminium chloride being a deliquescent salt (the deliquescence of aluminium chloride is mainly due to the presence of a small quantity of ferric chloride; see *below*), and, therefore, difficult to preserve, was soon replaced by the double chloride of sodium and aluminium, the reaction then being:

$$Al_2Cl_6,2NaCl + 6Na = 8NaCl + 2Al.$$

Nevertheless a small quantity of water is always retained, with the result that the aluminium produced is covered with a thin layer of oxide, which prevents the metal running together when remelted. For this reason Deville found it advantageous to add a little fluor-spar or cryolite to act as a flux.

The mention of this substance cryolite, the double fluoride of aluminium and sodium, $N_2Cl_6,6NaF$, leads us to the attempts which have been made to obtain aluminium from this natural product, attempts which have only lately been realised. The first experiments are those of H. Rose ('Pogg. Ann.,' September, 1855), in which alternated layers of sodium and finely powdered cryolite were heated to redness in an iron crucible, with potassium chloride as a flux. After half an hour's heating the mass was allowed to cool, and was then treated with water, the larger globules of aluminium being separated by means of a sieve from alumina and undecomposed cryolite. The metallic globules were then fused together under potassic chloride or, better, the double chloride of aluminium and sodium. The yield depends upon the proportion of large globules. The fusing together of the metal succeeds better the higher the temperature, but the heating must be proportionately shortened.

Deville subsequently experimented on this process, but found that the metal contained phosphorus and iron, and he eventually returned to the use of the double chloride, using cryolite only as a flux. (For recent process with aluminium fluoride, see *below*.)

The following are the final proportions used:

Double chloride of sodium and aluminum, $Al_2Cl_6,2NaCl$ . .	400	grammes.
Common salt, NaCl . . .	200	„
Fluorspar, CaF_2	200	„
Sodium, Na . . .	75 to 80	„

Deville also abandoned the distillation method, the above mixture being heated in crucibles lined with a mixture of lime and alumina, at first gently, and afterwards to the melting point of silver. Under the best conditions 23% to 25% of the aluminium was in the form of fine beads, and could not be recovered.

Watts thus summarizes the use of cryolite: "The chief inducement for using it as a source of aluminium is that it is a natural product obtained with tolerable facility, and enables the manufacturer to dispense with the troublesome and costly preparation of the double chloride of sodium and aluminium. But the metal thus obtained is less pure than that obtained by other processes. If earthenware crucibles are used, the metal is contaminated with silicon, because the sodium fluoride produced acts strongly on the siliceous matter of the crucible, while if an iron crucible is employed, the metal takes up some iron. The best use of cryolite is as a flux in the preparation of aluminium from the double chloride, in which case the slag is not fluoride of sodium but fluoride of aluminium, which acts but slightly on the containing vessel.

We now come to the manufacturing processes at present in use. The oldest is that based on Deville's method, and is the only one which furnishes pure aluminium. It has recently been brought to a high state of perfection owing to the invention of Mr Hy. Kastner, of New York, whereby sodium can be manufactured easily and at a low cost. It is carried out by the Aluminium Company at Oldbury, near Birmingham. Although the manufacture of sodium belongs to another section, it will be described here, as the manufacture of aluminium by Deville's process is intimately connected with the successful preparation of sodium.

The first process for producing sodium in

quantity consisted in heating together well-dried sodium carbonate, carbon and chalk, the mixture having the following proportions:

Sodium carbonate, Na_2CO_3 .	. 1000
Coal	. 450
Chalk.	. 175

The constituents were thoroughly dried and ground together to the finest powder, the success of the operation depending on the thoroughness with which this is effected. The object of the chalk is to make the mixture less fusible, and to prevent the separation of the carbon and alkali, which react according to the following equation:

$$Na_2CO_3 + 2C = 2Na + 3CO.$$

The mixture, after a preliminary calcining to decompose the coal, was heated to a white heat. Originally wrought-iron mercury bottles were used, but these were displaced at a later date by tubular retorts. A pipe led from the retort to a flat-shaped condenser, consisting of two iron plates about half inch apart. The high temperature required was very destructive to the retorts, and they were usually protected, either by a tube of graphite or by painting them with a mixture of alumina, sand, yellow earth, borax, and water-glass. A considerable loss of sodium is occasioned by the combination of the latter at the temperature of solidification with the carbonic oxide, to form a compound of sodium oxide and carbon.

Quite recently the process has been considerably simplified by the inventor mentioned above, his invention being the only step in advance since the time of Deville. He finds that the reduction of the sodium carbonate does not require a temperature above that of a red heat (1000° C.), the chief failure of the old process being due to the separation of the carbon and alkali, owing to the fusion of the latter. This difficulty is overcome by immersing the carbon in the fused alkali, caustic soda being employed on account of its easy fusibility. In order to make the carbon sink in the fused mass, it is weighted with iron. This is carried out practically by caking a mixture of finely divided iron and gas-tar, and grinding the resulting mass to a fine powder. It is then mixed with caustic soda and heated in retorts, when sodium and hydrogen distil over, and unaltered iron and sodium carbonate are left behind. Various reactions are possible, these depending upon the proportion between the carbon and the caustic soda. The retorts are heated by gaseous fuel, the body of the retort having the form of a crucible. This with its charge is raised through the furnace floor, its upper edge fitting into the retort head, which is permanently fixed in the roof of the furnace. A side tube serves to condense the sodium, which runs into an iron pot. As soon as the contents of one retort are exhausted, it is removed, recharged, and again put in its place, the process thus going on continuously.

The next operation in the Kastner process is the preparation of the double chloride of sodium and aluminium, which is prepared by heating a mixture of alumina, salt, and carbon in a stream of chlorine:

$$2NaCl + Al_2O_3 + 3C + 6Cl = Al_2Cl_6 2NaCl + 3CO.$$

For this purpose aluminium hydrate (for preparation see ALUMINA), common salt, and charcoal are ground together with water and formed into rolls. These are dried, and then heated in horizontal fire-clay retorts. The retorts are connected at one end with a chlorine main supplied from a gas-holder, and at the other with brick condenser chambers furnished with doors and an outlet for uncondensed gases. The mixture of alumina, charcoal, &c., is maintained at a red-heat for four hours, to ensure the dehydration of the alumina. The chlorine is then allowed to enter the retort. At first only carbonic oxide passes into the condenser chambers, but white fumes of the double chloride appear later, and the doors are closed. The chlorine continues to flow in for 72 hours. The double chloride condenses in the connecting tube and runs down into the chamber, where it solidifies to a white cake. The small residue in the retort is mixed with fresh material and used over again.

The double chloride thus prepared always contains iron, which materially detracts from the quality of the metal subsequently produced. Lately a means of purifying it has been devised, but the method is not yet published. The pure chloride is much less deliquescent than that containing iron. The last stage in the manufacture consists in heating the double chloride with sodium. The chloride is first ground with half its weight of cryolite, and the sodium, cut into thin slices, is then mixed with it in a revolving drum. The mixture is at once introduced into a rectangular furnace with sloping floor, which has previously been heated to a suitable temperature and closed. The reaction commences at once, and the mass liquefies. After some time the heating gas is again introduced, and the charge kept at a moderate temperature for about two hours. At the end of this time the metal and slag are run out. 1200 lbs. of double chloride, with 600 lbs. of cryolite and 350 lbs. of sodium, give 115 lbs. to 120 lbs. of aluminium.

Reduction of Aluminium Fluoride by means of Sodium. The disadvantages of using aluminium fluoride as a source of aluminium have already been sufficiently considered in the first part of this article; they consist mainly in the difficulty of obtaining a vessel in which to conduct the operation, a vessel which shall yield neither iron nor silicon to the aluminium. Herr L. Grabau ('Eng. Pat.,' 1887, Nos. 9904, 14356, and 15593) meets this difficulty by the ingenious device of cooling the containing vessel at the moment of reaction, so that the inside becomes coated with a solid crust of the slag produced, viz. the double fluoride, $Al_2F_6,6NaF$, itself.

In carrying out the process, sodium and powdered aluminium fluoride, Al_2F_6, are heated in separate vessels to 600°—700° C. (at this temperature the aluminium fluoride does not melt.) The sodium is now run into the decomposing vessel, which has double walls between which a cooling liquid circulates, and immediately afterwards the powdered aluminium fluoride is let in upon it. This arrangement is advantageous, as the sodium is covered during the whole reaction, which works from below upwards. A very high temperature

is produced, the reagents being taken in the proportions required to give the reaction :

$$2Al_2F_6 + 6Na = 2Al + Al_2F_6,6NaF.$$

The cryolite produced at once solidifies round the walls of the vessel, and forms a coating which is not attacked either by sodium or by aluminium fluoride.

As soon as the reaction is finished, the mass is tipped into another vessel with similarly coated walls and allowed to cool. The aluminium is then easily separated by breaking up the mass. The hot reaction vessel with its lining of cryolite is then ready for a second charge.

The aluminium fluoride required for this process is prepared in a state of purity by heating cryolite with a solution of aluminium sulphate, evaporating, and heating and washing with water to remove sodium sulphate, thus :

$$Al_2(SO_4)_3 + Al_2F_6,6NaF = 2Al_2F_6 + 3Na_2SO_4;$$

or by treating fluor spar, CaF_2, with aluminium sulphate, whereby a double fluoride and sulphate of aluminium is produced :

$$Al_2(SO_4)_3 + 3CaF_2 = Al_2F_4(SO_4) + 2CaSO_4 + CaF_2.$$

The latter is then dissolved out and heated with cryolite, which gives rise to aluminium fluoride and sodium sulphate :

$$3Al_2F_4(SO_4) + Al_2F_6,6NaF = 4Al_2F_6 + 3Na_2SO_4.$$

Reduction by Electricity. Numerous attempts have been made to reduce aluminium electrolytically from the fused double chlorides, or by a method similar to that which is so successful for magnesium fluorides, but these have never been practically successful, chiefly on account of the low specific gravity of aluminium, which causes it to rise to the surface, and of the difficulty of making the reduced particles of metal agglomerate. The containing vessel is also liable to introduce impurities. Better results have been obtained with the oxide in the form of corundum, or of artificially prepared alumina reduced in the presence of some metal with which it can alloy. Two methods of action are used: (1) in which the heat alone of the electric arc is employed to make the carbon and alumina react; (2) in which the aluminium oxide is submitted to true electrolysis, only sufficient heat being produced to fuse the oxide.

To the first of these belongs the process of Messrs E. H. and A. H. Cowles. The apparatus consists of a rectangular brick-work furnace lined with charcoal which has been saturated with lime, the object of this treatment being to maintain the non-conducting character of the lining, which otherwise becomes converted into a denser and better conducting form. In this furnace is placed the charge, consisting of 25 lbs. of corundum, 12 lbs. of charcoal and gas-retort carbon, and 50 lbs. of granulated copper. A thick layer of coarse charcoal is then placed on top, and the furnace closed by a fire-brick cover.

The electrodes, consisting either of single electric light carbons or bundles of these, pass through tubes in the ends of the furnace. They are connected by bundles of copper wire with the dynamo. In the circuit is placed an ammeter and a German silver resistance coil immersed in water.

At starting, the electrodes are brought near together, and a considerable resistance thrown into the circuit by means of the resistance coil, so that the current may not short-circuit. The ammeter is carefully watched, and the electrodes gradually drawn out as the copper melts. In about ten minutes the whole of it is melted and the current becomes steady. The whole current, about 5000 ampères, is now allowed to pass, the E.M.F. between the electrodes being about 60 volts. Carbonic oxide is soon given off and continues to be evolved for about 1½ hours, when the operation is at an end. A large resistance is now introduced and the current switched to another furnace. During the reduction the heat is sufficiently intense to volatilise the metals, which condense on the cover and trickle back through the charcoal. A furnace in which the metal can be continuously drawn off is now in use. The output is about 1 lb. of contained aluminium for 22 h. p. hours. (1 horse power = 33000×60 ft. lbs. of energy per hour; therefore energy expended in separating 1 lb. of aluminium from its oxide = $33000 \times 60 \times 22$ ft. lbs).

The Herault process, carried out by the Swiss Metallurgical Company at the Rhine Falls at Neuhausen, is based partly on electrolysis, partly on the heat of the voltaic arc. An iron box lined with carbon forms the negative electrode. In it is placed a mixture of alumina (prepared by chemical means) and iron and copper scrap, and the positive electrode—consisting of bundles of carbon slabs—is brought down upon the mixture. The heat due to the current soon fuses the charge, and the electrolysis of the fused oxide then commences, the decomposition being assisted by the oxidation of the positive electrode, which gradually burns away. The current for this process must obviously be continuous, whilst that used in the Cowles process may be alternating. It is important that the electrodes should be brought as near together as possible (about 3 mm. distance), owing to the large resistance of the electrolyte. This is effected by means of a mechanical arrangement, by which the positive electrode can be raised or lowered at will. Should the electrode come in contact with the reduced aluminium, the connection is almost immediately destroyed through the burning away of the carbon. The current is about 12,000 ampères per hour at 20 volts pressure. The yield is, on an average, 1 lb. of contained aluminium per 15 h. p. hours. (See *above*.)

The two foregoing processes will not give pure aluminium, but only alloys of that metal with copper and iron.

Properties. The aluminium obtained by early experimenters was very impure, containing sometimes sodium, silicon, and iron. The first two render it more easily oxidised, the last raises its melting point. Pure aluminium has a white colour with a slight bluish tinge. A fine white matt surface can be given to it by plunging it for an instant in dilute soda, washing well, and then dipping it in nitric acid. It may be polished by using equal weights of olive oil and rum, the two being shaken together until emulsified, and the polishing stone dipped in the mixture.

Aluminium can be forged or rolled with as much perfection as gold or silver, and can be

beaten out into thin leaves. It has a tensile strength of 12—14 tons per sq. in., *i.e.* equal, weight for weight, to that of steel of 38 tons. It can be easily drawn, care only being required in the annealing. When cast, its hardness is about equal to that of silver, but is somewhat increased by hammering. Its specific gravity is 2·58 (cast), 2·68 (rolled or hammered). Its melting point has been variously stated at 600°—1000° C. A sample containing ½% iron, made by the Kastner process, melted at 700° C.; one containing 5% showed incipient fusion at 730° C. (*Roscoe.*)

Aluminium is a good conductor of heat and electricity. Its specific heat is very high (·225), hence the metal takes a long time to cool down after heating. It is not oxidised in wet or dry air, either at the ordinary temperature or at a red heat. At the melting point of platinum it begins to oxidise. In thin leaves it burns in oxygen with an intense blue-white light. Sulphur has no action on it. It is not attacked by dilute sulphuric acid nor by dilute or concentrated nitric acid, but dissolves readily in hydrochloric acid and caustic alkalies. Its action on solutions of metallic salts is in accord with these facts, no deposition of metal taking place in solutions of nitrates or sulphates, readily, however, in solutions of chlorides.

Aluminium is largely used for purposes for which its lightness and unalterability in air adapt it, *e.g.* for making the beams of balances, scientific apparatus, jewellery, cooking utensils, &c.; the difficulty of soldering it being, however, a drawback. It is more largely used in the form of alloys, especially that with copper. This alloy is known as aluminium bronze, and contains a maximum of 10% of aluminium. It has the appearance and lustre of gold, is easily worked, hot or cold, can be readily cast, and possesses great strength. A still more important application of aluminium consists in alloying it in small quantities with iron and steel, whereby their melting points are lowered and sound castings more easily obtained. Castings of wrought iron have even been made in this way.

Aluminium, Detection and Estimation of.—Aluminium is not precipitated from acid solutions of its salts by sulphuretted hydrogen, but is thrown down as hydrate, $Al_2(OH)_6$, by ammonia or sulphide of ammonium (cf. *aluminium sulphide*); the hydrate is soluble in caustic alkalies, but insoluble in ammonia, hence an alkaline solution of it is precipitated on the addition of chloride of ammonium (difference from zinc). If alumina or any of the salts of aluminium is heated on charcoal before the blowpipe, and the residue then moistened with a solution of cobalt nitrate and strongly heated again, a characteristic blue mass is obtained. (The first heating is unnecessary when dealing with alumina itself.) Aluminium is usually estimated by precipitating hot solutions of its salts by ammonia, boiling off all excess of the latter, filtering, washing, and igniting the resulting hydrate to oxide, and weighing the latter. Compounds of alumina, which are insoluble in water, can be dissolved by fusing with carbonate of soda, and treating the fused mass with dilute hydrochloric acid. Spinelle and a few other minerals, however, are not decomposed in this way, but require to be fused with acid sulphate of potassium, $KHSO_4$.

Aluminium Salts, General Characteristics of. The salts of aluminium are colourless and readily soluble, so much so that they crystallise with difficulty. But the double sulphates with the alkali metals (alums) crystallise readily and beautifully. Aluminium salts impart no colour to the flame. When they are heated, their acid—if a volatile one—is driven off, a residue of alumina being left behind.

Aluminium Acetate. $(C_2H_3O_2)_4Al_2O + 4H_2O$. *Syn.* ACETATE OF ALUMINA. *Prep.* Pure hydrate of aluminium is treated, to saturation, with strong acetic acid in the cold, and the resulting solution, after being filtered or decanted, is either evaporated by a very gentle heat to a gelatinous, semi-solid consistence (its usual form), or is preserved in the liquid state. By spontaneous evaporation it may be obtained in long, transparent crystals.

(For preparation of aluminium acetate, red liquor, &c., for dyeing purposes, see DYEING.)

Uses. In dyeing and calico printing.

Therapeutic Uses. See ALUM and BURNT ALUM.

Aluminium Bronze. The preparation of an aluminium bronze is an excellent example of economy in manufacturing processes. At Newcastle the slag of the manufacture of aluminium by the sodium process is allowed to flow in a thin layer over molten copper, which takes up the particles of aluminium in the slag and forms an alloy, thus preventing waste both of fuel and of the metal. See ALUMINIUM and ALLOYS.

Aluminium Chloride. Al_2Cl_6. *Syn.* SESQUICHLORIDE OF ALUMINIUM; ALUMIN'II CHLORI'DI, &c., L. *Prep.* By passing chlorine over a mixture of carbon and anhydrous alumina heated to a red heat, in a manner similar to that followed for the double chloride of sodium and aluminium (See ALUMINIUM.)

Prop., &c. Volatile at a dull red heat; very hygroscopic, especially if it contains iron. Forms double compounds with many carbon compounds, and is useful for this reason in assisting the replacement of hydrogen by chlorine in organic compounds. (See ORGANIC CHEMISTRY.) It reacts with water with great energy, forming a solution of a hydrated salt, which on evaporation splits up into aluminium hydrate and hydrochloric acid, the latter being evolved.

Aluminium Nitrate. $Al_2(NO_3)_6$. *Syn.* NITRATE OF ALUMINA; ALU'MINÆ NI'TRAS, L. *Prep.* Similar to that of the acetate. (See DYEING.) Its concentrated acid solution deposits rhombic crystals of the composition $Al_2(NO_3)_6 + 18H_2O$.

Aluminium Oxide or Alumina. Al_2O_3; and Hydrate $Al_2(OH)_6$. Alumina occurs in nature crystallised (in hexagonal prisms) as the mineral corundum, of which there are several varieties. When coloured brown by ferric oxide, these are either translucent or opaque, and are termed corundum (of which emery is an impure variety); when coloured red by chromium compounds, ruby; and when coloured blue (probably by cobalt), sapphire. Combined with silica alumina forms innumerable silicates, which constitute the greater portion of the crust of the earth. Clay is a silicate of alumina.

Prop. Aluminium is precipitated as hydrated oxide or hydrate from solutions of aluminium salts on the addition of an alkali or alkaline carbonate, with evolution of carbonic anhydride in the latter case. The following is the best process:—Alum is dissolved in about 20 times its weight of distilled water, and the solution dropped slowly into a solution of ammonia until the latter is nearly, but not entirely, saturated, when the whole is set aside for some time. The clear supernatant liquid is then decanted, and the precipitate carefully washed three or four times with warm water, after which it is collected on a filter, again well washed with water, and pressed and dried between bibulous paper, either at the temperature of the air or at one not higher than 49° C. (120° F.). The product is pure hydrate of alumina, which is converted into oxide by exposure to a white heat in a covered crucible. Various methods have been followed for preparing the hydrate on a large scale for the manufacture of alum, metallic aluminium, &c. The most general is that of heating bauxite (a mixture of aluminium and iron oxides containing a little silica) with sodium carbonate to a red heat in a reverberatory furnace. The mass is afterwards systematically lixiviated with water to dissolve out the sodium aluminate, $Na_2Al_2O_4$, and the aluminium hydrate then precipitated from this by passing carbonic anhydride through the solution, sodium carbonate being re-formed.

An important improvement has recently been made on this process by the researches of Th. Bayer, of St Petersburg, by which the use of carbonic anhydride (CO_2) is dispensed with and a larger yield of alumina obtained. In the usual process the alumina and sodium carbonate are ignited in the proportion $Al_2O_3:Na_2O$, a larger quantity of soda not being used in order to economise the carbonic anhydride. The sodium aluminate formed begins to decompose almost as soon as it becomes dissolved, and before the liquid can be separated from iron oxide, &c.; hence only about 75% of the whole alumina is obtained. If sodium carbonate in the proportion $Al_2O_3:2Na_2O$ is used, the solution remains perfectly clear if protected from the atmosphere. Professor Bayer, however, finds that if some previously precipitated alumina is added to the liquid, aluminium hydrate gradually deposits in a crystalline form, the precipitation going on until the liquid has the composition Al_2O_3, 6NaHO (leaving the water out of account). This liquid can then be drawn off and used with a fresh quantity of bauxite. The precipitation can be started by carbonic anhydride or by the crystalline alumina, but other substances, including gelatinous alumina, are without effect.

Alumina can also be prepared by igniting cryolite, Al_2F_6, 6NaF, with carbonate of lime, the products being calcium fluoride and sodium aluminate. The latter is decomposed with carbonic anhydride into alumina and sodium carbonate. Cryolite can be decomposed in the wet way by boiling the finely ground mineral with caustic lime, calcium fluoride and sodium aluminate resulting. In order to decompose the latter, the clear solution is drawn off and mixed with powdered cryolite in excess. The sodium aluminate is by this means decomposed into alumina and sodium fluoride. The latter can be boiled with lime to recover the soda, while the calcium fluoride from these processes is used in glass making.

Prop., &c. Alumina, Al_2O_3, which has been precipitated and dried, is a white amorphous powder. The hydrate, $Al_2(OH)_6$, is freely soluble in acids and also in solutions of caustic potash and soda, from which latter it is precipitated by sal ammoniac. It gradually yields up its water on drying. After ignition at a moderate temperature, the resulting oxide can be dissolved by hot concentrated acids; but after strong ignition it is hardly affected by them. In the fused or crystalline state it is wholly insoluble.

Uses, &c. The alumina mordants generally consist of alumina or of basic aluminium salts when fixed upon the fibre. So powerful is the affinity of alumina for certain colouring matters that the moist precipitate, simply stirred into the solution of the dye, will completely decolourise it by forming an insoluble lake.

Aluminium Silicates. Of these the compound $Al_2(SiO_3)_3$ is, in its hydrated form, the chief constituent of common clay. It also occurs in many important and abundant minerals.

Aluminium Sul'phate. $Al_2(SO_4)_3$. *Syn.* Sesquisul'phate of Alumina, Neutral sulphate of A., Alu'minæ sul'phas, A. sesquisul'phas, L. *Prep.* Saturate dilute sulphuric acid with aluminium hydrate, gently evaporate and crystallise. (For preparation on a large scale see Alum, Concentrated alum.)

Prop. It crystallises with difficulty, is soluble in 2 parts of water, tastes like alum, and has an acid reaction.

Uses, &c. Improved processes of manufacture have enabled alum makers to prepare aluminium sulphate in a state of purity, without the necessity of converting it into the double salt; hence it is now largely used for purposes for which ordinary alum was formerly employed, thereby saving the cost of the alkali.

Aluminium Sulphide. Al_2S_3. A black powder which acquires a metallic appearance under the burnisher. Prepared by heating to whiteness a mixture of metallic aluminium and sulphur. It is decomposed by water, with evolution of sulphuretted hydrogen.

Aluminium Tannate. *Syn.* Tannate of Alumina, Eng.; Alum'inæ tann'as, L. *Prep.* Take of pure hydrate of aluminium (dried at 90° F.), 1 part; tannic acid (dried at 212° F.), 2 parts; triturate them together for some time, adding just sufficient water to bring them to the consistence of a syrup, and carefully evaporate the mixture to dryness at a temperature not higher than 120° F.; lastly, reduce the residuum to powder.

ALVELOS. A plant found in the interior of the province of Pernambuco and south of Parahyba. It grows in the fissures of the rocks where dry leaves and animal manure have accumulated. There are three distinct varieties of the plant, bearing the vernacular names of male, female, and wild alvelos. The plant appears to belong to the genus Euphorbia. The juice is supposed to have some specific action in cancer, and a resin prepared from the plant is made into an ointment with vaseline in Brazil. The action of the juice is irritating, producing a spreading dermatitis

without much pain, and the application of the cut stem or the juice of the fresh plant to the diseased part is said to result in the destruction of the morbid tissue, which is replaced by healthy granulations. (*Christy.*)

The juice of the so-called female plant is most used concentrated till it becomes solid and then dissolved in white vaseline for use. It is applied with a camel-hair pencil in a very thin layer every second or third day, leaving the sore exposed for two or three hours and then covering it with lint and dressings to absorb the fluids secreted.

ALVEOLAR. A word used in pathology to describe morbid structures consisting of small cavities or spaces (*alveoli*) with contents and bounded by walls of cells or fibres of Alveolar Cancer.

Alveolar Process. In *anatomy*, that surface of the upper and lower jawbones which contains the cavities for the teeth in old age. This process, as the teeth fall out, becomes absorbed and gives a characteristic appearance to the mouth in old people.

ALVEOLI. In *anatomy*, cavities or spaces in organs and glands, *e. g.* alveoli of the lung, lymphatic glands, &c.

AL'VINE (-vĭn). *Syn.* ALVI'NUS, L.; ALVIN, Fr. Of or from the belly or intestines; relating to the intestinal secretions.

AMABELE. Consists of crushed millets. See MILLET.

AM'ADOU (-ăh-dōō). *Syn.* GERMAN TINDER, TOUCH'WOOD, PYROTECH'NIC SPONGE, SPUNK‡§, SURGEON'S AG'ARIC, A. OF THE OAK, &c.; AGAR'ICUS QUER'CÛS, A. QUER'NUS, A. CHIRURGO''RUM, FUN'GUS QUER'CÛS, &c., L.; AMADOU, AGARIC AMADOUVIER, Fr.; ZUNDERSCHWAMM, Ger. A soft, spongy, combustible substance, being the prepared flesh of *Bole'tus fomenta''rius*, Linn. *Polyporus fomentarius*, an indigenous species of fungus found on the oak, birch, and a few other trees (REAL AMADOU or OAK-AGARIC); for which *B. ignia''rius*, Linn., a like fungus, found on the willow, cherry, plum, and other trees, is frequently substituted.

Collec., Prep., &c. The outer bark of the fungus (collected in August or September) having been removed with a knife, the inner spongy substance is carefully separated from the woody portion lying below, and after being cut into slices, is well beaten with a mallet until sufficiently soft and pliable. Sometimes it is first boiled in water, in order to separate the epidermis and porous parts, and to free it from soluble matter; after which it is beaten as before. In this state it is used in *surgery*, &c. Both *P. fomentarius* and *P. igniarius* are used. To complete its manufacture for TINDER, it is soaked once, or oftener, in a strong solution of saltpetre (RED AMADOU; BROWN A.); or in a thin paste made of gunpowder and water, which is thoroughly forced into the pores (BLACK A.); after which it is dried, and well rubbed to free it from loose matter. The first is the more cleanly; the last the more combustible.

Uses, &c. A light brown or reddish-brown substance. In *surgery*, *pharmacy*, &c., it is used to stop local bleeding, to spread plasters on, as a compress, and for other like purposes. When covered with resin-plaster it forms an excellent article for the protection of abraded surfaces. A small piece thus prepared, of circular shape, having a round hole cut in the middle, the size of the apex of the corn, is one of the very best corn-plasters known; as from its great softness it at once protects the part from pressure, and removes the cause. As a material for shoe-socks it is superior to all other substances. The amadou for surgical purposes must not contain nitre.

P. squamosus and *P. betulinus*, when pressed, sliced, and prepared by rubbing with pumice, &c., are used to make razor-strops.

P. anthelminticus, a native of Savoy, in the Jenasserim province of Burma, is known as Shan-wo (the Worm Mushroom), and is there highly esteemed as an anthelmintic.

AMAL'GAM. [Eng., Ger.] *Syn.* AMAL'GAMA, L.; AMALGAME, Fr. An alloy of mercury (see ALLOY). Medallists improperly apply this term to all soft alloys.

Formation and Preparation. Mercury unites with many of the metals upon mere contact. Generally speaking, but little heat is given out in the formation of amalgams, excepting in the case of those of the alkali metals, when the reaction is a decidedly violent one, with the evolution of much heat and light; in the case of the alloys of tin, lead, and bismuth, heat is absorbed. Further, with a few exceptions (of which the alloys of silver and copper are the chief), little or no contraction in volume occurs. Most amalgams may be prepared by agitating or rubbing together the mercury and the other metal or metals, the latter being in a finely divided state, and heat being applied if necessary; or, in the case of the easily fusible metals, by adding the mercury to them in the molten state, care being always taken that the temperature shall not rise so high as to volatilise the mercury. For other modes of formation, see Watt's 'Dictionary of Chemistry,' 2nd ed.

Amalgam, Ammonium. When a globule of mercury is placed in a small cavity formed in a piece of sal ammoniac, and the negative pole of a strong galvanic battery is brought into contact with the metal, the positive pole being in contact with the ammonium salt, a bulky spongy mass of the so-called ammonium amalgam at once begins to be formed. A simpler plan for obtaining it is to add a little (of a 1%) sodium amalgam to a concentrated solution of ammonium chloride. Opinions differ as to whether this voluminous mass is a definite compound of mercury with ammonium (NH_4), or whether it is merely a froth of mercury, ammonia (NH_3), and hydrogen; it very rapidly decomposes into these bodies.

Properties. Some amalgams are solid and not unfrequently crystalline, while others are liquid; of the latter, several crystallise after a time. Many solid amalgams appear to be chemical compounds in definite proportions (*e.g.* those of copper, silver, and lead); while many of the liquid ones may be regarded as solutions of definite compounds in excess of mercury (*e.g.* those of potassium and sodium), and others as solutions of metals in mercury (*e.g.* some of the iron amalgams).

Uses, &c. The amalgamation of gold is widely practised for the extraction of that metal from the quartz in which it occurs. The amalgams of

gold, silver, tin, zinc, cadmium, &c., are extensively employed in gilding and silvering, and for dentistry and many other purposes. (For these, see the respective metals.)

Amalgam, Elec'trical. *Prep.* 1. Take of zinc and grain-tin, of each, 1 *oz.*; melt them in an iron ladle, remove it from the fire, and add of mercury (hot), 3 *oz.*; stir the whole well together with an iron rod, pour it into a well-chalked wooden box, and agitate it violently until cold; or, instead of this, it may be briskly stirred until cold, and then powdered. It should be preserved in a corked glass bottle.

2. (*La Baumé.*) Zinc, 2 *oz.*; grain-tin, 1 *oz.*; bees' wax, ½ *oz.*; melt, add of mercury, 6 *oz.*, and otherwise proceed as before. Preferred by some to all other mixtures.

3. Zinc, 2 *oz.*; mercury, 5 *oz.*

Use. To cover the cushions of electrical machines. A little of the powder is poured on a piece of paper, crushed smooth with a flat knife, and then spread thinly on the surface of the cushion or rubber, previously slightly smeared with tallow; or the powder may be rubbed down with a little tallow prior to the application of it.

Amalgam, Gild'ing. *Syn.* AMALGAM OF GOLD. *Prep.* Take of grain-gold, 1 part; mercury, 8 parts; put them into a small iron saucepan, or ladle, and apply a gentle heat, using a smooth piece of iron as a stirrer; when the solution or combination is complete, pour it out on a clean plate or smooth stone slab.

Use. To gild brass, copper, &c., in the common process of wash or fire-gilding. A less proportion of gold than the above is used when a thin and cheap gilding is required; as by increasing the quantity of the mercury the same weight of the precious metal may be extended over a much larger surface.

Amalgam, Magnetic. A fancy name given to a compound of metallic sodium 1 part, metallic mercury 30 parts. This is liquid at a very moderate heat, but solidifies on cooling to a hard crystalline mass. It is cast into ingots, which are kept in air-tight vessels with lime to absorb any moisture, which would convert the sodium into soda. This amalgam has been exported to the gold and silver mines for working up ores. It encourages amalgamation and prevents *flouring*, q. v.

Amalgam, Var'nishers'. *Prep.* Melt grain-tin, 4 *oz.*, with bismuth, 1 *oz.*; add quicksilver, 1 *oz.*, and stir till cold; then grind it very fine with white-of-egg or with varnish, and apply the mixture to the figure or surface with a soft brush. It is used in several of the ornamental trades.

Amalgams, Dentists'. One made of cadmium 1 part, mercury 3 parts, is employed by dentists occasionally. See DENTISTRY and TOOTH-CEMENTS.

Amalgams, Sil'vering. *a.* For METALS. *Syn.* AMALGAM OF SILVER. *Prep.*, *Uses*, &c. As the last, but substituting silver for gold.

b. For GLASS. *Prep.* 1. Lead, tin, and bismuth, of each, 1 *oz.*; bees' wax or resin, ¼ *oz.*; melt, skim off the dross, cool to the lowest point at which the mixture will remain liquid, and add of quicksilver 10 *oz.*; mix well with an iron rod.

2. Lead and tin, of each, 1 *oz.*; bismuth, 2 *oz.*; quicksilver, 4 *oz.*; as the last. See MIRROR.

Uses, &c. For silvering the insides of hollow glass vessels, globes, convex mirrors, &c. The glass being thoroughly cleaned and dried, is carefully warmed, and the amalgam, rendered fluid by a gentle heat, is poured in, and the vessel turned round and round, so as to bring the metal into contact with every part which it is desired to cover. At a certain temperature it will be found to readily adhere to the glass. The excess is then poured out, and the vessel set aside to cool.

AMAL'GAMATED. *Syn.* AMALGAMA'TUS, L.; AMALGAMÉ, Fr. Compounded or blended with quicksilver; formed into an amalgam.

AMALGAMATING SALTS. Boil a solution of pernitrate of mercury with excess of equal parts of powdered persulphate and perchloride of mercury, and decant the liquid portion of the result for use. Chiefly used for amalgamating the zinc plates of galvanic batteries, also as a substitute for mercury in gilding by the amalgam process.

AMALGAMA'TION. [Eng., Fr.] *Syn.* AMALGAMA'TIO, L.; VERQUICKEN, Ger. The act or process by which an amalgam is formed; hence loosely, the mixing or blending of different things. In the art of the refiner, the operation of separating gold and silver from their ores by means of mercury. See SILVER and GOLD.

AM'ANDINE (-dēne). *Prep.* 1. (Transparent.) *a.* Fine new white or pale honey, 4 *oz.*; white soft-soap (prepared from lard and potassa), 2 *oz.*; mix thoroughly in a marble mortar, adding 1 or 2 teaspoonfuls (if necessary) of solution of potassa, until a perfectly homogeneous paste or cream is produced; then rub in, by degrees, and very gradually, of oil of almonds, 7 *lbs.* (or q. s.), previously mixed with essential oil of almonds, 1 *oz.*; essence (oil) of bergamot, ¾ *oz.*; oil of cloves, ½ *oz.*; and balsam of Peru, 3 *dr.* The product, which should have a rich, transparent, jelly-like appearance and behaviour, is, lastly, put into pots for use or sale.

b. (*G. W. S. Piesse.*) Simple syrup, 4 oz.; white soft-soap (see *above*), 1 oz.; oil of almonds, 7 *lbs.* (previously scented with—); essential oil of almonds and bergamot, of each, 1 *oz.*; oil of cloves, ½ *oz.*; the whole being mixed, &c., as before. Both the above are of very fine quality. Glycerin, in the proportion of about ½ *oz.* to each *lb.* of the products, added with the soap, improves their softening quality.

2. (*Opaque.*) *a.* From white potash-soap and gum-mucilage (thick), of each 3 *oz.*; new white honey, 6 *oz.*; and the yolks of 5 large eggs; well mixed together, and afterwards intimately blended, first, with oil of almonds (scented as before, or at will), 2 *lbs.*; and afterwards, with thick pistachio-milk (made of the freshly peeled nuts and rose-water), 5 *fl. oz.*

b. From almond-paste, honey, white potash-soap, and glycerin, of each. 1 *oz.*; yolk of 1 egg; oil of almonds, ½ pint (holding in solution—); essential oil of almonds, 1 *dr.*; balsam of Peru, ½ *dr.*

Uses, &c. To whiten and soften the skin, and to prevent its chapping. A small portion, about half the size of a filbert, with a few drops of warm water, produces a very white and rich lather, with which the hands and face are lightly

rubbed, and the skin, in a short time, gently wiped with a small napkin, whilst the water on it is still milky.

The manufacture of AMANDINE is a matter of some difficulty and labour. The details essential to success are given under EMULSINES. It is sometimes coloured, which is done by infusing or dissolving in the oil, before using it, a little—spinach-leaves, for GREEN; and palm-oil, or annatto, for YELLOW and ORANGE. A beautiful SCARLET or CRIMSON tinge may be given to it by a liquid rouge or carmine (ammoniacal), added just before removing it from the mortar. See EMULSINES, OLIVINE, PASTE, &c.

AMANI'TA MUSCA"RIA. The fly-agaric or fly-mushroom. See AGARIC.

AMARA. [L.] In *medicine* and *pharmacology*, the bitter tonics.

AMARANTH. *Syn.* AMARANTH'US, L.; AMARANTE, Fr. The flower love-lies-bleeding (*Amaranthus caudatus*, Linn.). In *poetry*, an imaginary flower that never fades (*Milton*). In *chromatics*, a colour inclining to purple.

AMARYTH'RINE. A bitter principle found, in certain lichens, associated with erythrine (which *see*).

AM'ASI. This, the native name given by the natives of Central Africa to sour milk, which they prepare by adding to the new milk, a small quantity of milk previously allowed to become sour. The milk thus acidified is considered by them far more wholesome than new milk.

AMAURO'SIS. Gr. ἀμάυρος (amauros), dark. A term used to imply defective vision, and, as a rule, restricted to those cases in which the ophthalmoscope reveals nothing. Syphilis, tobacco smoking, in some persons lightning and other agencies, produce forms of blindness which are described as amaurotic.

AM'BER. *Syn.* ἤλεκτρον, Gr.; ELEC'TRUM, AMBRA FLAVA, SUC'CINUM (Ph. D.), L.; AMBRE, SUCCIN, Fr.; BERNSTEIN, AGTSTEIN, GELBES ERDHARZ, Ger.; LYNX-STONE†, LA'PIS LYN'CIS†, L. A well-known yellowish, semi-transparent, fossil resin, of which trinkets and the mouth-pieces of pipes are commonly made.

Nat. Hist., &c. Amber is found in detached pieces on the sea-coast, and is dug up in alluvial soils. That of commerce comes chiefly from the southern coasts of the Baltic, where it is cast ashore between Königsberg and Memel; and from Ducal Prussia, Saxony, Poland, Sicily, and Maryland (U.S.), where it is dug out of beds or mines. It has also been found on the shores of Norfolk, and small pieces are occasionally dug up in the gravel pits round London. It has likewise been found in Southern Germany, in France, Italy, Spain, Sweden, and Norway; on the shores of the Caspian Sea, in Siberia, Kamtschatka, China, India, and Madagascar. It is probably a fossil resin; and when found on the coast is supposed to be disengaged, by the action of the sea, from neighbouring beds of lignite or fossil coal. Much diversity of opinion for a long time prevailed amongst naturalists and chemists as to the origin of amber, some referring it to the vegetable, others to the mineral, and some even to the animal kingdom; its natural history and analysis affording something in favour of each. The vegetable origin of amber has, however, been recently shown by various facts, and is now generally admitted. According to Sir David Brewster, its optical properties are those of an indurated vegetable juice ('Ed. Phil. Journ.,' ii). Insects and fragments of vegetables are frequently found embedded in it; and this in a manner which could only have occurred when the resin was a viscid liquid. Microscopical researches have led to the conclusion that it is the production of some species of pine, closely allied to the *Pinus balsamea* ('Entom. Trans.,' i & ii).

Amber, Composition of. According to Schrotter the composition of amber is as follows: Carbon, 78·94; hydrogen, 10·53; oxygen, 10·53.

Manuf. Amber is WORKED in a lathe, POLISHED with whiting and water or rottenstone and oil, and FINISHED OFF by friction with flannel. During the operation the pieces often become hot and electrical, and fly into fragments; to avoid which they are kept as cool as possible, and only worked for a short period at a time. Amber is JOINED and MENDED by smearing the surface of the pieces with linseed or boiled oil, and then strongly pressing them together, at the same time holding them over a charcoal fire, or heating them in any other convenient way in which they will not be exposed to injury. The commoner varieties are HARDENED and rendered CLEARER, either by boiling them in rape oil for about 24 hours, or by surrounding the pieces with clean sand in an iron pot, and exposing them to a gradually increasing heat for 30 or 40 hours. During this process small fragments are kept in the sand at the side of the pot, for the purpose of occasional examination, lest the heat be raised too high, or be too long continued. These processes are more or less fraudulent, and are used to raise the value of inferior pieces.

Prop., &c. Hard; brittle; tasteless; glossy: generally translucent, but sometimes opaque, and occasionally, though rarely, transparent; colour generally yellow or orange, but sometimes yellowish-white; becomes negatively electric by friction; smells agreeably when rubbed or heated; fracture conchoidal and vitreous or resinous; soluble in the pure alkalies, and, without decomposition, in oil of vitriol, which then becomes purple; insoluble in the essential and fixed oils without long digestion and heat; soluble in chloroform; melts at about 550° F.; burns with a yellow flame, emitting at the same time a peculiar fragrant odour, and leaving a light and shiny coal. By dry distillation it yields inflammable gases, a small quantity of water, a little acetic acid, a volatile oil (OIL OF AMBER; O'LEUM SUC'CINI, L.) at first pale, afterwards brown, thick, and empyreumatic, and an acid (SUCCIN'IC ACID; ACIDUM SUCCIN'ICUM, L.); with residual charcoal 12% to 13%. Sp. gr. 1·065 to 1·09, but usually about 1·070. It cannot be fused without undergoing more or less chemical change.

Ident. Amber may be known from mellite and copal, both of which articles are occasionally substituted for it, by the following characteristics:—1. MELLITE is infusible by heat, and burns white; 2. A piece of COPAL, heated on the point of a knife, catches fire, and runs into drops, which flatten as they fall; 3. AMBER burns with spitting

and frothing, and when its liquefied particles drop, they rebound from the plane on which they fall (*M. Haüy*); 4. Neither mellite nor copal yields succinic acid by distillation; nor the agreeable odour of amber when burnt; nor do they become so readily electric by friction.

Uses. It is chiefly made into mouth-pieces for pipes, beads for necklaces, and other ornaments and trinkets. It is also used as the basis of several excellent varnishes. In *medicine,* it was formerly given in chronic coughs, hysteria, &c.—*Dose* (of the powder), 10 to 60 gr. Its properties were very doubtful and it has long since gone out of use.

Remarks. The finer sorts of amber fetch very high prices. A piece 1 *lb.* in weight is said to be worth from 10*l.* to 15*l.* 5000 dollars a few years since were offered in Prussia for a piece weighing 13 *lbs.*, and which, it was stated by the Armenian merchants, would fetch from 30,000 to 40,000 dollars in Constantinople. It is more valued in the East than in England; and chiefly on account of the Turks and other Orientals believing it to be incapable of transmitting infection. In the royal cabinet, Berlin, there is a piece weighing 18 *lbs.*, supposed to be the largest ever found. The coarser kinds alone are employed in medicine, chemistry, &c.

Amber, Ac′id of* (ăs′-). Succinic acid.

Amber, Bal′sam of. *Syn.* BAL′SAMUM SUC′CINI, L. The thick matter left in the retort after the rectification of oil of amber; and which it resembles in its properties.

Amber, Facti′′tious (-tĭsh′-). *Syn.* SUC′CINUM FACTI′′TIUM, L. Mellite, copal, and anime, have each been substituted for amber, especially for small fragments of it. Recently an imitation has been produced by acting on gutta percha with sulphur, at a high temperature, which, either alone or in combination with copal, is said to have been extensively passed off for genuine amber. A mixture of copal, camphor, and turpentine is extensively used as a substitute for genuine amber, which it closely resembles in appearance.

Kauri, or New Zealand gum, is largely worked up as amber, and the difficulty of distinguishing really good pieces from real amber is so great as frequently to deceive experts.

Amber, Liq′uid†. See LIQUID-AMBAR.

Amber, Oil of. See OILS.

Amber, Re′sin of. See PYRÉTINE.

Amber, Salt of. Succinic Acid.

Amber, Sol′uble. *Prep.* Fragments of amber are cautiously heated in an iron pot, and as soon as it becomes semi-liquid, an equal weight of pale boiled linseed-oil, previously made hot, is very gradually stirred in, and the whole thoroughly blended. Used as a cement for glass and earthenware, and thinned with oil of turpentine to make varnishes. It will keep any length of time if preserved from the air.

AMBER-CAM′PHOR. See PYRÉTINE (Crystalline).

AM′BER DRINK†. Amber-coloured malt liquor.

AM′BER-SEED. Musk-seed (which *see*).

AM′BER-TREE. The popular name of a species of *Atherosperma,* q. v., an evergreen shrub, of which the leaves, when bruised, emit an agreeable odour.

AM′BERGRIS (-grĭs; grēse‡). *Syn.* GREY AMBER*; AMBRAGRI′′SEA (grĭzh′-e-ă), L.; AMBREGRIS, Fr.; AMBRA, AMBAR, Ger. An odorous, solid substance, found floating on the sea in tropical climates, and in the cæcum of the cachalot or spermaceti-whale (*Physeter macrocephalus*); only in such as are dead or sick. It has been supposed by some to be a morbid secretion of the liver or intestines, analogous to biliary calculi; but according to Mr Beale, it consists of the mere indurated fæces of the animal, perhaps (as suggested by Brande and Pereira) somewhat altered by disease. "Some of the semifluid fæces, dried with the proper precautions, had all the properties of ambergris" (*Beale*). It is occasionally found in masses weighing from 60 to 225 *lbs.* No large piece has ever been found without a larger or smaller quantity of the beaks of the *Sepia octopodia*—the common food of the sperm-whale—interspersed through its substance, thus leaving but little doubt of its origin in the intestines of the animal. If it were the result of a disease produced by the *Sepia,* it would be much more frequently found without the beaks embedded in it.

Prop., &c. Solid, opaque, ash-coloured, streaked or variegated, fatty, inflammable: remarkably light; highly odorous. Pereira says (*Redwood,* 'Gray's Supplement,' 1857, p. 606) it has a "pleasant musk-like odour, which is supposed to be derived from the squid (*Sepia moschata*), on which the animal feeds," the "horny beaks" of which "are often found embedded in the masses." Redwood, l.c., describes the "smell as resembling that of dried cow-dung," particularly when warmed, cut, or handled—the odour being peculiar and not easily described or imitated, of a very diffusive and penetrating character, and perceptible in minute quantities; rugged on the surface; does not effervesce with acids; melts at 140°—150° F. into a yellowish resin-like mass; at 212° sublimes as a white vapour; very soluble in alcohol, ether, and the volatile and fixed oils. It appears to be a body analogous to cholesterine. Sp. gr. 0·780 to 0·926; ·780 to ·896 (*Brande*); ·908 to ·920 (*Pereira*).

Pur. From the high price of genuine ambergris it is very frequently, if not nearly always, adulterated. When quite pure and of the best quality, it is: 1. Nearly wholly soluble in hot alcohol and ether, and yields about 85% of ambreine; 2. It almost wholly volatilises at a moderate heat, and when burnt leaves no notable quantity of ashes; a little of it exposed in a silver spoon melts without bubble or scum; and on the heated point of a knife it is rapidly and entirely dissipated; 3. It is easily punctured with a heated needle, and on withdrawing it, not only should the odour be immediately evolved, but the needle should come out clean, without anything adhering to it (*Normandy*); 4. Acids, except nitric acid, act feebly on it; alkalis combine with it and form a soap. The Chinese are said to try its genuineness by scraping it fine upon the top of boiling tea. "It should dissolve (melt) and diffuse itself generally." Black or white is bad. The smooth and uniform is generally factitious (Ure's 'Dict. of A., M. & M.,' 5th ed., i, 128).

Uses, &c. It is highly prized for its odour,

which is found greatly to improve and exalt that of other substances; hence its extensive use in perfumery. In *medicine* it was formerly given as an aphrodisiac, in doses of 3 to 10 gr. "A grain or two, when rubbed down with sugar, and added to a hogshead of claret, is very perceptible in the wine, and gives it a flavour, by some considered as an improvement" (*Brande*).

Ambergris Facti′′tious. An article of this kind, met with in the shops, is thus made: Orris-powder, spermaceti, and gum-benzoin, of each, 1 *lb.*; asphaltum, 3 or 4 *oz.*; ambergris, 6 *oz.*; grain-musk, 3 *dr.*; oil of cloves, 1 *dr.*; oil of rhodium, $\frac{1}{2}$ *dr.*; liquor ammoniæ, 1 *fl. oz.*; beaten to a smooth hard mass with mucilage, and made into lumps whilst soft. This fraud is readily detected.

AMBLYOPIA. Weakness of vision. See AMAUROSIS.

AMBOYNA WOOD. A beautiful ornamental wood said to be imported from Singapore and supposed to be furnished by a species of *Pterocarpus*. Sometimes known as Kiabooca Wood.

AM′BREINE (-bre-ĭn). *Syn.* AMBREI′NA, L. AMBREINE, Fr.; AMBARSTOFF, Ger. The fatty, odorous principle of ambergris.

Prep. Digest ambergris in hot alcohol (sp. gr. 0·827) until the latter will dissolve no more, then filter. The AMBREINE will be deposited as the solution cools, in an irregular crystalline mass, which may be purified by recrystallisation in alcohol.

Prop., &c. Melts at about 90°; volatilises at 212°—220° F.; nitric acid converts it into AMBREIC ACID. It closely resembles cholesterine. —*Prod.* 85%.

AMBRETTE′ (-brĕt′). [Fr.] Musk-seed.

AMBROSIA. A word variously signifying the food, the drink, and the anointing oil of the gods, was named from the Greek *a*, not, and *mbrotos*, *mrotos*, *mortos*, mortal. It was also applied to several plants, notably to a herb allied to the wormwood, *Ambrosia artemisifolia*, called the oak of Cappadocia. The sage and the betony were also so named.

AMBROSIA, RING'S VEGETABLE (*Tubbs*, Peterborg, U.S.). A liquid with a sediment, containing 1% of lead (*Chandler*).

AMBULANCE. AMBULANCE, HÔPITAL AMBULANT, Fr., from the Latin AMBULARE, to move from place to place. Until recent years the term ambulance was practically confined to military hospitals moving with armies in the field and organised for the purpose of rendering first aid to the wounded; more recently it has been adopted as a name for similar organisations for rendering like assistance to the sick and injured under all circumstances. Thanks to the exertions of certain societies and associations, in all civilised countries ambulance corps exist, either volunteer or paid, and the police and other public servants are instructed in the methods necessary for rendering first aid to the sick and injured. The term ambulance is also applied very generally to the specially constructed carriages and stretchers used for the removal of the injured from the scene of an accident to the nearest hospital. The whole of such an organisation, including the surgeons, bearers, and their apparatus is often spoken of as 'the ambulance.'

A detailed account of military ambulance organisation would be out of place here, but the following particulars will serve to give some idea of the general plan on which the sick and wounded are provided for in time of war.

Immediately behind the fighting line are stationed 'Bearer Companies,' as they are called, with surgeons and a supply of the more necessary surgical appliances and stretchers; these men assist the wounded at once, under fire, and convey them as rapidly as possible to a 'Collecting Station,' which is placed as near the fighting line as is consistent with safety, but may be, and often is, under fire. The Red Cross flag is hoisted over it, and it is understood that, so far as the exigencies of the situation permit, this station shall not be fired upon by the enemy. Here further assistance is rendered, such surgical operations as are urgent are performed, and the patients are dressed and bandaged in such a way as to permit of their rapid removal to the 'Dressing Station,' where they are further attended to and sent on to the nearest 'Field Hospital,' or second line of medical assistance. From this they are removed to 'Stationary' hospitals on the line of communication, from which they are passed on as soon as practicable to the 'General Hospital' at or near the base of operations, from which they are conveyed as soon as their condition will permit to other hospitals further removed from the seat of war, or to their own homes.

The conditions of modern warfare are such that no conceivable organisation can cope satisfactorily with the enormous number of wounded which result from a general engagement between two armies of the size brought into the field by the great Powers, but the recognition of the fact that the care of his wounded is one of the first duties of a general, the great development of the military ambulance system in recent years, together with the now recognised neutrality of the wounded and their attendants, as established by the Geneva Convention, 1864, has done much to mitigate the sufferings and loss of life among the wounded in battle. Nor should it be forgotten that a victory very seriously increases the responsibility of the generals in command and of the ambulance organisation at the disposal of the victorious army; for, in addition to their own wounded, those of the enemy are to a very large extent thrown upon their hands, the lines of communication are strained to the utmost by the passage of reserves to the front to take the place of those disabled in action and by a proportional increase in the numbers on their way to the rear.

Brief directions for rendering first aid in the accidents and diseases of ordinary life will be found under separate headings. Considering how much may often be done in cases of accident by the right use of a very small amount of knowledge, it behoves everyone to make himself acquainted with these simple methods of treatment, so that, if occasion should arise, he may be able to render some practical assistance.

AMENTIF′ERÆ or **AMENTA′CEÆ.** A name applied to a group of plants which bear their flowers in amenta or catkins. It includes a number of trees and shrubs, chiefly inhabiting temperate climates; they are apetalous and uni-

sexual, and are divided into the following orders: Salicaceæ, willows and poplars; Corylaceæ or Cupuliferæ, hazel, oak, beech, chestnut, hornbeam, &c.; Betulaceæ, birch and alder; Casuarinaceæ, beef-wood; Altingiaceæ or Balsamifluæ, liquid-ambar; Platanaceæ, the planes; Juglandaceæ, walnut; Garryaceæ, garrya; Myricaceæ, the bog myrtle.

AMERICAN HORSE DISEASE. A name given to an outbreak of influenza in horses which broke out in Toronto, Canada, on October 1st, 1872. In nine days nearly every horse in the city was affected, and carriages were not to be had at any price. On October 18th it had reached Montreal and prevailed throughout Canada. On October 14th it had reached Buffalo; on the 17th, Rochester; on the 22nd, Boston, New York, Brooklyn, and Jersey City; on the 27th, Philadelphia; on the 28th, Washington. It made its appearance in Nova Scotia on October 13th. The nature and treatment of the disease will be found under INFLUENZA IN HORSES.

AMERICAN UNIVERSAL BLOOD-PURIFYING HERB TEA (*Dr Kuhr*), for women's diseases, hysteria, nervous debility, epilepsy, stomachic complaints, asthma, hæmorrhoids, gout, rheumatism, worms, and much besides. White horehound, marsh mallow, liquorice wood, and sassafras, of each, 10 parts; anise, coriander and fennel, of each, 5 parts; red poppy petals, 4 parts; lavender flowers, 2 parts; senna, peppermint, millefoil flowers, and valerian root, of each 1 part (*Kuhr* and *Selle*).

AM'ETHYST (-thĭst). *Syn.* PURPLE ROCK-CRYSTAL; AMÉTHYSTE, Fr.; AMETHYS'TUS, L. A beautiful sub-species of quartz or rock crystal, of a violet-blue colour of varying intensity, due to oxides of manganese, in great request for cutting into seals, brooches, and other like articles of ornament. It was known and prized in the earliest ages of antiquity. Among the ancients, cups and vases were made out of this mineral; and it was an opinion of the Greeks and Persians that an amethyst bound on the navel would counteract the effects of wine, and that wine drunk out of an amethystine vessel would not intoxicate. Hence its name, according to Pliny. When heated the stone loses its colour, passing through yellow and green. Amethyst is now found in great abundance in the Brazils and has consequently lost some of its former value as a gem. The finest stones come from Ceylon and Siberia, but their distribution is very general throughout the world. Two centuries ago very excellent counterfeit amethysts were made in France from coloured glass, but the decline in the value of the stones makes these forgeries no longer profitable.

Amethyst. In *dyeing*, &c., a rich variety of deep violet colour. Hence, AMETHYST'INE (ĭn), &c.

Amethyst, Orient'al. A rich violet-blue variety of transparent, crystallised corundum.

AM'IANTH (-e-ănth). *Syn.* AMIANTH'US, AMIAN'TUS, L.; AMIANTE, Fr. The whiter and more delicate varieties of asbestos, particularly those which possess a satiny lustre. The name signifies *unstained*.

AMIDES, MONAMIDES. Compounds (usually solid) derived from ammonia, NH_3, by the replacement of one third of its hydrogen by a monovalent acid radicle; *e.g.* acetamide, $(CH_3\text{-}CO)\text{-}NH_2$, the group $(CH_3\text{-}CO)'$ being the monovalent radicle of acetic acid $(CH_3\text{-}CO)\text{-}OH$. We are likewise acquainted with DI-AMIDES, which may be considered as derived from two molecules of ammonia by the replacement of one third of the total hydrogen by a divalent acid radicle; *e. g.* oxamide, $C_2O_2(NH_2)_2$, the diamide of (the dibasic) oxalic acid, $H_2C_2O_4$.

AM'IDIN (-e-dĭn). [Eng. Fr.] *Syn.* AM'YDINE; AMIDI'NA, L. A name given to the soluble portion of starch.

AMIDO-ACIDS. Acids derived by the replacement of one or more hydrogen atoms in the hydrocarbon radicle of an organic acid by the group amidogen $(NH_2)'$. Examples: amido-acetic acid (glycocoll), $CH_2(NH_2)\text{-}CO_2H$; amido-benzoic acid, $C_6H_4(NH_2)\text{-}CO_2H$.

AMIDOGEN. The unsaturated group $(NH_2)'$, which can only exist in combination. See AMINES, AMIDES, and AMIDO-ACIDS.

AMINES. A most important class of compounds derived from ammonia by the replacement of hydrogen in it by alcoholic radicles. They are either mono-, di-, tri-, or tetra-amines, according as it is considered that their molecule is derived from one, two, three, or four molecules of ammonia (NH_3). Monamines are further divided into primary, secondary, and tertiary, according as one, two, or three of the hydrogen atoms of the ammonia have been replaced. Amines may belong either to the fatty or to the aromatic series, thus, ethylamine, $C_2H_5NH_2$, and phenylamine (aniline), $C_6H_5NH_2$, are both examples of primary monamines; ethylene diamine, $C_2H_4(NH_2)_2$, and phenylene diamine, $C_6H_4(NH_2)_2$, examples of diamines, and so on. Pyridine and quinoline, &c., likewise belong to the class of the amines, but they are constituted differently from those mentioned above.

The amines as a class behave in the same manner as ammonia, forming salts with acids, and their hydrochlorides double salts with chloride of platinum, &c., &c.; the fatty amines containing the lower alcohol radicles, *e. g.* ethylamine, resemble ammonia very closely indeed, being highly volatile and possessing the same pungent odour as the latter.

An extraordinarily large number of amine bases and compounds derived from them are now known. The most important of those possessing technical interest will be mentioned individually, but for an account of the constitution, formation, and properties of the amines generally, the reader must consult either Watt's Dictionary, or some good text-book of organic chemistry.

AMMI VISNAGA, Lam., a plant brought from Africa and the Levant to Marseilles. The 'rays' of the umbels are used as tooth-picks.

AMMONIA. NH_3. *Syn.* AMMONIA GAS, AMMONIACAL GAS, ANHYDROUS AMMONIA; AMMONIAQUE, Fr.; AMMONIAK, Ger.

Ammonia occurs in the air, in rain-water combined with nitrous and nitric acids, and in the neighbourhood of active volcanoes in the form of sulphate and chloride. It has been supposed that the name of the latter salt, sal-ammoniac, is derived from that of the Armenian volcanoes, its possible source. As, however, Geber, in the eighth

century, was acquainted with its preparation from urine and common salt, it is doubtful whether the sal-armoniacum of the Ancients was of volcanic origin. Ammonia also occurs in sea-water, in bituminous coal, in urine, in guano, and especially in the air of large towns. The minute stellated crystals sometimes found on dirty windows in London and other populous cities consist of sulphate of ammonia. It is also found in clayey and peaty soils. In the free state it exists in the juices of some plants and in the living blood of animals; and it is freely developed during the decomposition of nitrogenous vegetable substances, and during the putrefaction of animal matter.

Prod. and Prep. Ammonia may be produced directly from its elements by means of the silent discharge (see ELECTRICITY), and is formed—generally speaking—when one of its constituents is present in the nascent state. Thus ammonia is obtained when a mixture of hydrogen and any of the oxides of nitrogen is passed over spongy platinum; also by the action of nascent hydrogen on nitrous or nitric acids or their salts, preferably in alkaline solution, when the hydrogen is liberated by aluminium. Messrs Gladstone and Tribe's copper-zinc couple (see ELECTRICITY) also reduces solutions of nitrates when heated with them, the reaction being sufficiently complete to allow of their estimation by this means. Ammonia is also produced when steam is passed over alkaline cyanides heated to about 300° C.:

$$KCN + 2H_2O = KHO + NH_3 + CO;$$

in minute quantity as ammonium nitrite when water is evaporated in contact with air:

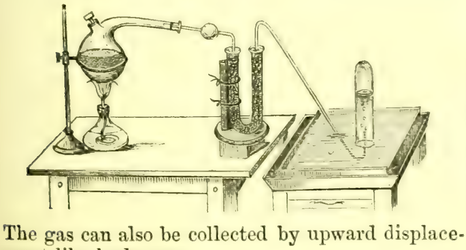
$$2N + 2H_2O = NH_4NO_2;$$

and by the putrefaction of animal and vegetable matter, and their destructive distillation. It is by the last process, in the distillation of coal, that the greater portion of the ammonium compounds of commerce is produced.

For laboratory purposes ammonia is usually prepared by heating any of the salts of ammonium with slaked lime, sal-ammoniac being generally chosen:

$$2NH_4Cl + Ca(OH)_2 = CaCl_2 + 2NH_3 + 2H_2O.$$

One part of powdered sal-ammoniac is well mixed with two parts of caustic lime, slaked to a fine dry powder, and the mixture introduced into a large retort. On applying a gentle heat the above reaction takes place, and ammonia gas is given off. It is passed through a U-shaped tube filled with lumps of caustic lime, in order to dry it, and is then collected over mercury (see *engr.*).



The gas can also be collected by upward displacement like hydrogen.

If the gas is required in quantity, for saturating solutions or similar purposes, it may be more readily prepared by warming commercial ammonia solution (sp. gr. ·880) in a flask over a water-bath, and passing the evolved gas through about 6 feet of glass tubing filled with lumps of caustic lime.

Manuf. Numerous processes have been devised for preparing ammonia synthetically on a large scale from the nitrogen of the air. These comprise methods for making nitrogen and steam react under the influence of porous substances (coke, &c.), or of using the silent discharge to effect a direct synthesis, or, lastly, of preparing boron nitride (BN), and decomposing this with steam. None of these processes, however, have been practically successful, the great difficulty of preparing ammonia synthetically being due to the fact that whilst the molecules of hydrogen and nitrogen require a very high temperature to dissociate them, that of ammonia already begins to decompose at 500° C.

The process which has been most successful up to the present time is based upon the action of steam on an infusible cyanide, such as barium cyanide, the latter being first produced by heating a mixture of baryta and carbon to an intense white heat in an atmosphere of nitrogen. L. Mond carries out these reactions by incorporating barium carbonate with coke or charcoal and pitch or oil residues. This mixture is made into briquettes and heated in a reducing flame until the pitch is carbonised. The briquettes are then charged into an annular kiln whose chambers are treated in rotation, some being heated whilst others are cooling. A gaseous mixture rich in nitrogen is introduced at a temperature of 1400° C., and the stream of gas continued until a sufficient quantity of cyanide has been produced. The gas is then turned into the next chamber, the mass just treated being allowed to cool down until a temperature of 500° C. has been reached. When this is the case steam is introduced, and continued so long as ammonia continues to be evolved, the ammoniacal vapour being condensed and concentrated in suitable apparatus. The residue, which consists of barium hydrate, is now ready to be used over again. This process can also be employed for the manufacture of cyanides. In the latter case the mass, after treatment with nitrogenous gases, is lixiviated with water, in order to extract the barium cyanide. The nitrogenous gases used were those obtained from the carbonic acid absorption apparatus of the ammonia-soda process. As the manufacture of ammonia in this way is no longer carried on, it is to be presumed that it was not commercially successful.

Ammonia from urine. As we have already seen, urine was probably the source from which the Ancients obtained their sal-ammoniac, and a small quantity of ammonia is even now obtained in this way at some of the places where sewage is chemically treated. The general plan consists in precipitating the solid constituents with lime or with sulphate of iron or zinc, and then submitting the clear liquid to distillation in stills constructed for the purpose. It may be mentioned that the quantity of ammonium sulphate theoretically derivable from London urine is equal to about 60,000 tons per annum.

Ammonia from bones. A further small quantity

of ammonia is obtained by condensing the tar formed in carbonising bones in the manufacture of animal charcoal. The aqueous portion of the distillate is separated and distilled.

Another source of ammonia is 'vinasse,' the residue left from fermented and distilled beet-root molasses.

Ammonia from coal. By far the greater proportion of the ammonia and ammonium compounds used in the arts is derived from the distillation of coal in the manufacture of lighting-gas (which *see*). When coal is heated in closed vessels, a large quantity of volatile constituents is given off. These are condensed partly in the hydraulic main and partly in the scrubbers. The aqueous portion of the condensed liquids contains the bulk of the ammonia. Coal contains from 1% to 2% of nitrogen which, on distillation, appears partly as ammonia (about one third), partly as other nitrogenous compounds. W. Foster ('Chem. Soc. Journ.,' xliii, p. 105) gives the following distribution of 100 parts of nitrogen after distillation:

14·50 as ammonia,
1·56 „ cyanogen,
35·26 „ free nitrogen in the gas,
48·68 remaining in the coke.

The bulk of the ammonia is found in the aqueous portion of the distillate, a small quantity, however, passing into the tar and into the spent oxide.

It will be seen from the above table that nearly half the nitrogen remains behind in the coke. As the ammonia forms a valuable by-product in the manufacture of coal-gas, various plans have been devised for increasing the yield. The most successful of these consists in mixing the slaked lime obtained from 2½ parts of quicklime with every 100 parts of coal. This proceeding undoubtedly increases the production of ammonia, sometimes doubling it, but it has the disadvantage of reducing the value of the spent oxide, Fe_2O_3 (by retaining sulphur), and also that of the coke.

Another method of increasing the yield of ammonia is to pass steam over the heated coke. This cannot, of course, be done in the manufacture of coal-gas, but is very advantageous in another exactly similar industry, viz. the distillation of bituminous shale.

Ammonia from bituminous shale. In Scotland large deposits of a bituminous shale occur, which are distilled, not for the sake of obtaining a permanent gas, but on account of the paraffin and shale oil which they yield. See SHALE OIL.

It has long been the custom in this case to recover the ammonia produced. This source of ammonia comes under the head of AMMONIA FROM COAL, and therefore it is not necessary to go into the details of the distillation, which is similar to that of coal.

Of late years the output has been multiplied 3- or 4-fold by heating the residual coke in a current of steam. The coal is first distilled in the usual way, and the ammonia and other products collected. A mixture of steam and air is then passed over the coke heated to low redness, until the whole of it is burned away. This is important, as the ammonia appears to be evolved only in proportion as the coke is volatilised. The steam appears to prevent the destruction of the ammonia by the high temperature, and to furnish the necessary hydrogen. Large quantities of water- and producer-gas are formed at the same time. See METALLURGY; GASEOUS FUEL.

Another source of ammonia from coal exists in the volatile bodies (tar and ammonia) produced in the manufacture of coke for metallurgical purposes. This industry is capable of furnishing very large quantities of ammonia, which will undoubtedly be utilised in the future. The amount saved at present is not very great, as the modifications in coking necessary for the recovery of the by-products somewhat deteriorate the quality of the coke. Moreover, the small proportion already introduced into the market from this source has sufficiently lowered the prices to render a further extension of this supply unprofitable. (It should be remarked that ammonium sulphate, commonly called sulphate of ammonia, has to compete as a manure—which is its chief application—with nitrate of soda, and hence a permanent rise in the price of the former cannot be expected unless the supply of the latter should fall short.)

Ammonia from blast-furnace gases. Where raw coal is used in the blast-furnace, as in the north of Scotland, the escaping gases are largely charged with tar and ammonia. Numerous processes have been devised for the recovery of these products, the main difficulty to be overcome being the high temperature of the gases and their enormous bulk. The most successful process for the recovery of the ammonia consists in blowing in sulphurous, sulphuric, or hydrochloric acids in the state of gas, and removing the ammonium salt formed by means of a scrubber, which must be cooled externally if the temperature of the gases is high. Sulphurous acid gas is found to be the most suitable, being produced for the purpose from sulphurous shale, pyrites, &c.

The ammonium sulphite is either oxidised to sulphate (see *below*), or else the ammonia is liberated at once and used for the ammonia-soda process, or for preparing liquor ammoniæ. Owing to the heat of the gases, the liquor becomes concentrated as it passes through the scrubbers, and may leave them at a strength of 40° to 50° Tw. It always contains some thiosulphate of ammonium (hyposulphite of ammonia).

Having now considered the various sources from which crude ammonia- or ammoniacal-liquor is obtained, it is necessary to examine its composition and the methods by which it is purified. The constituents of ammoniacal liquor from the distillation of coal (in gas-making, coke-burning, from blast-furnaces, &c.) may be divided into two classes, viz. the volatile constituents or those which are driven off when the liquor is boiled, and the fixed constituents or those which are not volatile with steam. The various salts in the two classes are enumerated in the following table (from Lunge's 'Tar and Ammonia Distillation'):

(*a*) Volatile at ordinary temperatures:
Ammonium carbonates (mono-, sesqui-, and bi-),
„ sulphide, $(NH_4)_2S$,
„ hydrosulphide, NH_4HS,
„ cyanide,
„ acetate (?)
Free ammonia.

(*b*) Fixed at ordinary temperatures:
Ammonium sulphate,
„ sulphite,
„ thiosulphate (hyposulphite),
„ thiocarbonate,
„ chloride,
„ thiocyanate (sulphocyanide),
„ ferrocyanide.

Also salts of organic (especially pyridine) bases, phenols, and other 'tarry' products.

The ratio of fixed to volatile ammonia varies considerably. Thus, in the hydraulic main, where condensation first takes place, the fixed ammonia may form 50% of the total, whilst in the scrubbers it will not amount to more than 1% or 2%. The percentage of fixed ammonia will also be influenced by the temperature of the gas retorts, the extent to which the gas-liquor has been heated, and the greater or less exposure to air which it has undergone (oxidation of sulphide to sulphate occurs in presence of air). Free ammonia occurs in the liquor at the top of the scrubber, but, as the liquid descends, the ammonia becomes saturated with carbonic acid gas and sulphuretted hydrogen. If the liquor is used over and over again, the sulphuretted hydrogen may become entirely displaced by carbonic acid In this case the greater portion of the sulphur will be found in the spent oxide.

According to Lunge, liquor from English coals contains from 15% to 20% of the total ammonia in the fixed state, that from Westphalian coals 5% to 10%, whilst in liquor from Saxony coals the amount of fixed ammonia may be 2 or 3 times that of the volatile.

The following table from the same authority exhibits the amount of total ammonia contained in gas-liquor from various sources:

Coal Distilled.	Grms. of NH_3 per 100 cc.	Degrees, Baumé.	Gas-Works.
Cannel Coal, Boghead	2·881	3·75	Hamburg.
English coal	3·514	4	Stettin.
	2·659	3	St. Petersburgh.
	2·244	3·3	Trieste.
	2 142	3·5	Stralsund.
Leverson Wallsend; Old Pelton Main	2·366	4	Altona.
English coal	2·407	4	Copenhagen.
New Pelton; Ravensworth	1·785	2·75	Riga.
Old Pelton Main	1·717	3	Königsberg.
English coal	2·966	3	Stettin.
Old Pelton Main; Leverson Wallsend	1·345	3	Dantzic.

Valuation of Ammoniacal Liquor. This is frequently determined by means of the hydrometer. The results so obtained are, however, very erroneous, as the different salts of ammonium affect the density in a different degree. It is therefore preferable to determine the amount of ammonia by titration (see ALKALIMETRY and VOLUMETRIC ANALYSIS). For this purpose a normal solution of sulphuric acid is run into 20 cc. of the gas-liquor until the acid is in excess. About 40 cc. should be sufficient. The liquor is then boiled to drive off carbonic acid gas and sulphuretted hydrogen, litmus added, and the liquor titrated back with normal soda or $\frac{N}{2}$ ammonia. The excess of the acid and the boiling are necessary, on account of the discolouration which sulphuretted hydrogen produces in litmus. By using azo-colours as indicators, it is possible to titrate directly in the cold, as these colours are not affected by the above gases (see ACIDIMETRY, ALKALIMETRY, INDICATORS). Methyl-orange, also known as 'helianthine' (dimethyl-aniline-azo-benzene-sulphonate of soda), is the most suitable.

In England gas-liquor is usually stated in 'ounces,' the latter representing the amount of real sulphuric acid required to neutralise each gallon of gas-liquor. To prepare the standard acid, 16½ *oz.* of the best rectified sulphuric acid is diluted to a gallon, which is then supposed to contain 16 *oz.* of real sulphuric acid (H_2SO_4). The specific gravity should be 1·068 at the ordinary temperature (1·064 at 15° C., *Lunge*). It is, however, much better to standardise the acid by means of sodium carbonate. See ACIDIMETRY and ALKALIMETRY.

In order to make the estimation, 16 *oz.* of the gas-liquor are taken, and the standard acid run in from a burette, graduated in ounces, until the liquid is neutral to litmus-paper. The number of ounces used represents the number of ounces of real sulphuric acid which would be required to neutralise 1 gallon of the liquor.

When using the hydrometer, it is customary to double the number of degrees Twaddell, and to consider this as 'ounces' per gallon. The advantage is usually on the side of the buyer.

The above titration is known as the 'saturation test,' and gives the amount of 'volatile' ammonia. If the standard acid contains exactly 16 *oz.* of real sulphuric acid per gallon, each ounce used will represent 0·3469 *oz.* of anhydrous ammonia per gallon.

If the total ammonia be required, a given volume of the liquor must be distilled with excess of soda, lime, or magnesia, preferably the first, and the vapour passed into excess of standard acid. When all the ammonia has been driven off, the excess of acid is determined by means of standard alkali. The liquor should be distilled for at least an hour (Lunge recommends 3 hours).

Note.—Lime is useful in the above distillation when it is desired to obtain a result exactly comparable with that obtainable by the manufacturer.

For the complete analysis of gas-liquor, see L. Dyson, 'Journ. Soc. Chem., Ind.,' 1883, p. 229, and Lunge's 'Coal-tar and Ammonia,' p. 575—578.

Concentration and purification of ammonia liquor. The various liquors produced at the gas-works are usually stored, preferably underground, prior to being distilled and converted into sulphate. In this connection it should be remembered that gas-liquors, if stored for a length of time, deteriorate considerably from volatilisation of ammonia. To avoid this as much as possible, it is usual to charge fresh liquor into the bottom of the tank and to withdraw it from the same place. Although, as shown above, there is a considerable difference in the composition of the liquor obtained from the hydraulic main and that from the scrubbers, yet it is not usual to treat these separately, the liquors from all sources being run into the same tank to await distillation, &c. Before this is carried out, tarry matter in suspension should be allowed to settle as much as possible. By applying this precaution, much less annoyance is likely to be caused in the neighbourhood of the works.

Distillation of crude ammonia-liquor. It is obvious, from the analysis of liquor already given, that the greater portion of the ammonia can be driven off by the action of heat alone, the fixed ammonia (amounting only to a few per cents. of the total ammonia) remaining behind, and requiring for its liberation the use of lime. The amount of fixed ammonia is so small that it was formerly thought advisable to run it to waste rather than complicate the process by the addition of lime. According to Lunge, however, the treatment with lime pays very well if the fixed ammonia amounts to 5%, although even the whole of this cannot be driven off.

A good rule for calculating the amount of lime necessary, is to add 50 lbs. of lime per 1000 galls. of liquor for every 100 gr. of fixed ammonia per gall.; that is, 350 of lime to 100 of fixed ammonia. According to Lunge, the fixed ammonia is usually one fifth of the total ammonia in liquor from German gas-works.

In every case all the volatile ammonia should be driven off before the addition of lime, on account of the trouble which the latter causes. This is chiefly due to frothing and to the production of crusts of calcium hydrate and lime salts on the bottom and sides of the still. The first is said to be due to calcium carbonate in suspension, and it has been proposed to slightly acidulate the liquor before adding lime. Incrustation occurs chiefly where the stills are heated by direct fire, a drawback which is avoided in some of the more recent stills by the use of steam as the heating agent.

As we have already seen, under the analysis of gas-liquors, a considerable time is required to drive off the whole of the ammonia, and it is rarely economical to do so. Hepworth (report of the Leeds meeting, October 6, 1883, 'Journal of Gas-lighting, &c.') gives the following as the distribution of ammonia on distillation:

Expelled by boiling alone	76·9%
„ by treatment with lime .	20·5%
Left in waste	2·6%
	100·0%

Magnesia is used instead of lime only in the ammonia-soda process. See ALKALI MANUFACTURE.

In the previous matter the main conditions connected with the distillation of ammonia have been described. It yet remains to consider the methods still used. To give a detailed description would be beyond the scope of the present work, especially as the different modifications are very numerous. The heating is generally effected by means of steam, either applied externally or, preferably, by blowing it through the liquid. (The latter plan is available in most cases where the volatile substances are to be separated. It cannot, however, be followed where the residue is to be evaporated, as in the extraction of potassic chloride from beetroot molasses after distillation.) In some apparatus the liquor is simply distilled in iron boilers, the vapour being deprived of water by means of a reflux apparatus and one or two washings through gas-liquor, these being systematically returned to the boiler. In most cases, however, they are modifications of Coffey's still, first used for the rectification of spirit (which *see*). Where lime is used, it is advantageous to arrange the apparatus so that the liquor only comes in contact with the lime after the volatile ammonia has been driven off. This is usually effected by making the liquor pass first through a modified Coffey still and then, by means of a large pipe, allowing it to drain into a boiler containing the lime, where it gives up the rest of its ammonia and furnishes the necessary steam for the working of the still. If direct fire is used for heating, means must be provided for preventing the lime mud from settling on the bottom of the boiler. This is effected in Grüneberg's still by providing an inner vessel, into which the liquor and lime first find their way. A valve is fitted at the bottom of the vessel for drawing off the lime sludge. The development of the soda-ammonia process has led to the production of very perfect stills capable of recovering enormous quantities of ammonia. In fact, it may be said that the success of the process largely depends on the completeness with which the ammonia is recovered. The requirements are here somewhat different, as the greater portion of the ammonia is 'fixed.' For a description of various 'plant,' the reader must refer to books on the subject.

Absorbing the Vapours in Sulphuric Acid. The ammonia having been separated from the non-volatile acids and from the bulk of the water in the still, is passed direct into sulphuric acid contained in an apparatus known as the saturator.

The saturator consists of shallow rectangular vessels lined with lead, and divided into two compartments by a vertical partition (called the curtain), which dips below the surface of the acid. One compartment is covered in, and is provided with an exit tube for carrying off the sulphuretted gases, the other being open to the air. The crude ammonia gas enters the acid through a rose placed in the closed compartment; the evolved gases are

thus completely trapped, and can only escape by the exit tube. Any crystals which separate can be removed by means of rakes inserted under the curtain. The acid must, of course, always be kept at a level above the lower edge of the latter, otherwise leakage of gas will occur. This arrangement is much preferable to a hood, since a very powerful draught is necessary for the latter, the sulphuretted gases present being thereby largely diluted and their recovery rendered more difficult.

Two methods of saturation are adopted. In one, dilute sulphuric acid (of 80°—100° Tw.) is used; in the other, strong acid (of 140° Tw.).

In the first case, owing to the dilution of the acid, ammonium sulphate does not crystallise out when the acid is saturated, and it is therefore necessary to draw off the liquor and evaporate it, preferably by means of a steam coil. In the second, after the acid has been neutralised to a certain point, the ammonium sulphate begins to crystallise out notwithstanding the high temperature of the solution. The crystals are fished out from time to time, fresh acid being run in to supply the place of that removed. The process is thus continuous.

The first method yields the purest sulphate, as the liquor can be allowed to clarify, but it entails evaporation and the simultaneous evolution of noxious gases (dissolved sulphuretted hydrogen, &c.). The liquor should be left slightly acid after saturation, as whiter crystals are thus obtained, and there is less likelihood of loss of ammonia on boiling, from dissociation of the sulphate.

In England, sulphuric acid made from brimstone is used for the manufacture of ammonium sulphate, in order to avoid the introduction of iron and arsenic, and so to obtain white crystals. In Germany, acid from pyrites is used, and the salt has a slightly grey colour. The pyrites should be tolerably free from arsenic, or a yellow salt will be produced. Acid made from Spanish pyrites, the ore used by vitriol makers in England, is bad for this reason. Several plans, however, can be followed for the removal of the injurious arsenious sulphide. One is to skim it off as it rises to the surface when the acid is neutralised; this, however, necessitates an open saturator. Another method is to add a small quantity of pitch, oil, or fat to the acid, and to carry on the saturation at a high temperature (by using strong acid). Under these circumstances a scum is formed on the surface which contains the arsenic and iron. A much better plan for producing the same effect is to add to the acid a quantity of 'vitriol-tar,' *i. e.* acid which has been used for purifying benzene, and which contains tar in solution. As the acid becomes neutralised in the saturator, the tar is thrown out of solution and comes to the surface, carrying with it the arsenious sulphide which has also been precipitated. The prejudice against sulphate made from pyrites is rapidly going out in England (*Lunge*). The sulphate is equally good as a manure whether it be made from pyrites or brimstone acid.

Sulphurous acid has been used for neutralising the crude ammonia of the stills, the resulting sulphite being afterwards converted into sulphate by exposure to air. This process, however, has been chiefly successful in connection with blast-furnace ammonia.

Treatment of Gases and Waste Liquors in the Saturation Process for the Prevention of Nuisance. This is a most important consideration for the ammonium sulphate manufacturer, and although the subject of nuisances in connection with chemical manufactures is considered in another section, a short treatment of the case as affecting ammonia manufacture will be useful here.

The following, taken verbatim from Lunge's 'Coal-tar and Ammonia,' will give an idea of the principal sources of nuisance and of their treatment.

"1. The reception, transference, or storage of the ammoniacal liquor. This can be made innocuous, wherever the sulphate-works are within reasonable distance of the gas-works which produce the ammoniacal liquor, by conveying it by means of pipes. Dr Ballard ('Report of the Medical Officer to the Local Government Board for 1878') recommends underground pipes, but we should decidedly prefer overground pipes wherever possible, as in the former kind leakages may occur, and continue for a long time without being detected. Wherever the liquor has to be conveyed to a greater distance, tank-waggons or barges are employed, exactly similar to those used for conveying gas-tar, and similar precautions should be taken in both cases. Pipes should be laid from the gas-works to the place of loading; the tank or hold of the boat should not be covered with loose planks in the perfunctory way often noticeable, but closely; the tar or liquor should be introduced by a close conduit; and, to prevent all nuisance, provision should be made for the escape of air from the tank through a box containing trays charged with hydrated iron peroxide. Tank-waggons should be charged from elevated reservoirs by a hose, through a man-hole at the top, without exposure to the air; the man-hole is afterwards closed by a tightly screwed-down lid. On arriving at the sulphate of ammonia works, the liquor should be run or pumped into the reservoirs with similar precautions, the vent through which the air must escape being guarded by a small oxide of iron purifier.

"2. Leakages about the apparatus may cause local escapes of foul gases. This may occur about the angles or edges of the curtain in fishing-boxes, by lids not being properly fastened down, by insufficiently luting the curtain with liquor, and the like. Nuisances arising from such cases must be instantaneously detected by those in charge of the works, and can be prevented by ordinary care.

"3. The waste liquor and lime from the stills may likewise cause nuisance. Usually these waste liquors are discharged whilst hot, and the slight proportion of ammonia they contain is then given off, and causes a very perceptible smell in the neighbourhood. The obvious remedy is to thoroughly exhaust the liquors. Dr Ballard mentions that Mr Stewart, of Clayton, reduces the ammonia in the liquor down to 0·002%. The hot waste of the still should not be conveyed away by an open channel, but by a pipe. Before reaching a common sewer or public water-course, it

must necessarily pass through a settling tank, both in order to separate the solid refuse from the liquor, and to completely cool the latter before it gets into any sewer with which house drains communicate, or into any water-course in which fish exist. The settling tank should be covered over, and should be ventilated merely by a pipe of sufficient length to condense any vapours rising through it. The lime deposit (which contains a great deal of calcium sulphide) should never on any account get into the sewers or water-courses, where it is sure to give off sulphuretted hydrogen. Even when it is entirely kept back in the settling tank, it may cause nuisance when being disturbed for removal, and, again, when depositing it on a heap. It should therefore be removed as expeditiously as possible, and with all possible precautions against unnecessary exposure to the air. It should be covered up during transmission from the premises, and, if shut down in any open place where it is likely to be a nuisance, the surface of the heap should at once be covered with earth and patted down. Wherever that is not possible, it is best to excavate large pits in the ground, which, after being nearly filled with waste lime, are covered up with soil again. But in this case care must be taken that no nuisance arises by foul drainage from such pits."

Notwithstanding the above precautions, it may happen that the waste liquor from the stills may cause nuisance, and as in some localities the conditions may be very strict in this respect, it may be necessary to submit the waste to a further treatment. For this purpose most of the forms of plant used for the treatment of sewage can be used. Dr Lunge describes one used at Essen where the discharged liquor is treated with the requisite quantities of solution of lime and copperas, the two reagents being added separately and in the order given. Suitable settling basins are provided, and the clear liquid run into a neighbouring water-course. Easily decomposed and evil-smelling compounds are completely decomposed by the above reagents, and tarry matters are precipitated.

The most common source of complaint, however, is the large quantity of sulphuretted gases which are evolved from the saturator. The following extract from Dr Lunge's work will give the best treatment for different cases:

"In some cases it seems sufficient to discharge these gases from the separator into a tall chimney shaft. Especially where they can be first brought into communication with hot furnace gases, this seems to suffice for removing the nuisance, as is proved by some works in Manchester, where shafts of 180 and 195 feet serve for this purpose. Where the liquor is worked up at the gas-works themselves, there is never any difficulty of that kind, as the immense volume of highly-heated gases coming from the retort fires is far more than sufficient to burn and dilute all effluvia from the ammonia plant. But in other cases where there is no very tall chimney shaft, or even with a tall shaft but an unfavorable conformation of the country, a thorough combustion of the gases must be aimed at. This is ordinarily done by carrying them by a pipe from the saturator into the side of the boiler fire, or under the grate, or sometimes into a fire specially kept up for this purpose. But unless care be taken to remove the large quantity of watery vapour contained in the gases, the object in view will be imperfectly performed, or even quite frustrated by the vapours extinguishing the fire. It should, therefore, never be neglected to provide means for condensation. At some works the pipe which conveys the gases is continued into a worm, passing through a tank filled with gas-liquor or with water for feeding the steam boilers, which are thus heated up previous to use. At the Plymouth gas-works an 8-inch pipe from the saturator is first carried beneath the floor on which the sulphate is dried, and thence runs along the surface of the ground, where it is bent upon itself, for a distance of about 500 feet, in the course of 290 feet of which it is played upon by jets of water flowing from a perforated pipe above it. At the Stampshaw works the 8-inch pipe from the saturator is first carried round the outside of the building at the eaves, and then enters a worm-condenser. At Illingworth's works at Bradford special care is taken to remove the watery and any other condensable vapour, as the sulphuretted hydrogen is there utilised for the manufacture of sulphuric acid. The gases are first conducted into a chamber, made of an old boiler, through which the pipe conveying the liquor to the Coffey still passes, and they thus serve to warm the liquor; then by a pipe to two iron towers, divided by partitions springing at opposite sides alternately in such a way as to make a tortuous passage for the vapour; and, lastly, from these towers through a long series of vertical iron pipes, bent upon themselves in the manner of a continuous condenser, such as is used in gas-works, water being made to flow continually down the outside of the pipes from a perforated water-pipe above. Other means for cooling the gases, and condensing the watery vapour therefrom, will be mentioned when describing in detail some of the varieties of plant observed by myself.

"The condensed liquor, if not quite cold, may by itself cause a nuisance, and should therefore be cooled down before discharging into a public drain.

"The combustion of the dried gases is usually carried out by making them pass through a small coke fire, and the sulphurous acid produced by the combustion of the sulphuretted hydrogen is usually discharged with the fire gases up the chimney, and thus thrown away. Sometimes the gases are burned by themselves, *e. g.* at Messrs. Forbes and Abbott's works at Old Ford, where they enter by a 1-foot square opening into a small fire-brick chamber and thence into a fire-brick flue, about 15 ft. long, 2 ft. 6 in. wide, and 3 ft. high; air is supplied by a small circular hole in an iron plate near the entrance of the gas, and the gases are ignited. Once the chamber and the flue are red-hot, there is no fear of the gas being accidentally extinguished without re-lighting. The heat thus generated is then utilised for heating steam boilers, which are said to have lasted fourteen years without receiving any injury by corrosion from the acid gases. The products of combustion, containing a large proportion of sulphur dioxide, are sent up the chimney shaft."

A drawback to the above processes, where the works are large, is that the sulphurous acid gas may itself become a nuisance. Moreover, in these processes the sulphur is wasted. This may be avoided by utilising the sulphurous acid gas for the manufacture of sulphuric acid, the hot gases being passed round nitre pots and then introduced into the lead-chambers in the usual way. The large amount of air, however, which is mixed with the gas, is likely to interfere with the process. Lunge recommends the use of Schaffner and Helbig's process (see SULPHURIC ACID and SODA), in which a portion only of the sulphuretted hydrogen is burnt to sulphurous acid gas, and this caused to react with the rest, with the formation of water and sulphur:

$$SO_2 + 2H_2S = 2H_2O + S_2$$

The sulphur so produced can then be used for the manufacture of sulphuric acid in the usual way. A process which is largely used is that patented by C. F. Claus (B.P. 3606, 1882), in which the sulphuretted hydrogen mixed with a limited supply of air is passed over layers of porous oxides, such as ferric or manganic oxide, or pumice saturated with sulphate of copper, iron, or zinc, the reaction then being:

$$H_2S + O = H_2O + S$$

The thickness of the layer used depends on the quantity of sulphuretted hydrogen contained in the gas. After the partial combustion, the products pass through chambers where the sulphur is deposited. When hydrated oxides of iron or manganese are used, the reaction, after once being started, furnishes enough heat to keep the oxides at the requisite temperature.

Instead of burning the sulphuretted hydrogen, as in the above processes, it may be directly absorbed, after being cooled, in the manner usually adopted for the purification of coal gas, either lime or ferric hydrate being used. The latter is naturally the best, as it creates no nuisance when moved, and the sulphur which it contains can be applied to the manufacture of sulphuric acid.

One last source of nuisance in the manufacture of sulphate of ammonia arises in the sulphuretted gases evolved when ammonium sulphate liquors are evaporated (in the discontinuous process). This can be avoided by blowing steam through the liquor in the saturator, previous to running off for evaporation.

Preparation and Manufacture of Liquor Ammoniæ. Formerly liquor ammoniæ was prepared by heating sal-ammoniac with slaked lime, and condensing the evolved gases in water. Later, ammonium sulphate was used on account of its greater cheapness. Now, however, very little ammonia is produced by distilling ammonium salts with lime, as it is found to be more expeditious to purify crude ammonia liquor. The latter, in a moderately concentrated state, may be prepared by passing the crude vapour into water or, more easily, by keeping the top of the (Coffey's) still cool, and drawing off the condensed liquid, sufficient lime being added, in either case, to combine with all the acids which the gas-liquor contains. The crude liquor so obtained (containing 4% to 5% of anhydrous ammonia) is contaminated with small quantities of volatile acids and tarry matters. When a discontinuous distillation is used, it is best to pass the first portion of the vapour which comes over into sulphuric acid, the latter portion only being employed for preparing liquor-ammonia. By this means the large amount of tarry matter which comes over with the first portion of the distillate is avoided.

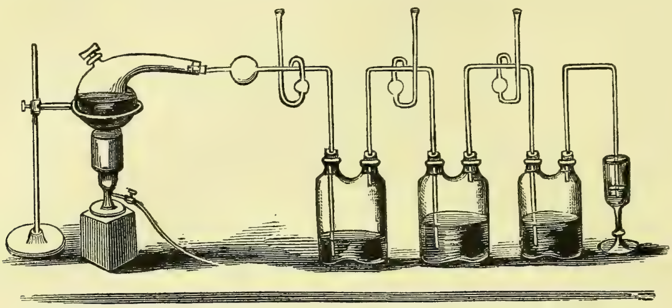
The various methods for obtaining pure ammonia solution of sp. gr. ·880 from this crude liquor consist essentially in redistilling the latter after addition of excess of lime, and, after freeing the vapour as much as possible from water by means of a reflux arrangement, passing it over lime and wood charcoal contained in suitable vessels, and then into pure water.

A simple arrangement for the manufacture of pure liquor-ammonia consists of an ordinary boiler fitted preferably with a reflux arrangment, and connected with a series of tanks made of iron or wood lined with lead, and containing trays of slaked lime. Beyond these are a series of absorption vessels, constructed on the principle of a Woulff's bottle. They must be provided with an hydraulic inlet valve to prevent regurgitation, and with taps for drawing off the strong liquor into carboys. The boiler is charged with crude ammonia liquor mixed with a large excess of milk of lime. The absorbers are charged with pure water.

Instead of adding lime in the redistillation of crude ammonia liquor, it is sometimes usual to employ ferric hydrate or a soluble salt of iron or manganese. A very ingenious process is that followed by Kunheim and Co.; it consists in blowing air through the crude liquor, whereby the ammonium sulphide is dissociated, and a mixture of air and sulphuretted hydrogen obtained. This is then passed through ferric hydrate, suspended in lime-water, with the result that ferrous sulphide and sulphur are at first produced, the former being at once re-oxidised to ferric hydrate with deposition of sulphur. The escaping gases are passed into sulphuric acid, for the sake of the small quantity of ammonia which they contain.

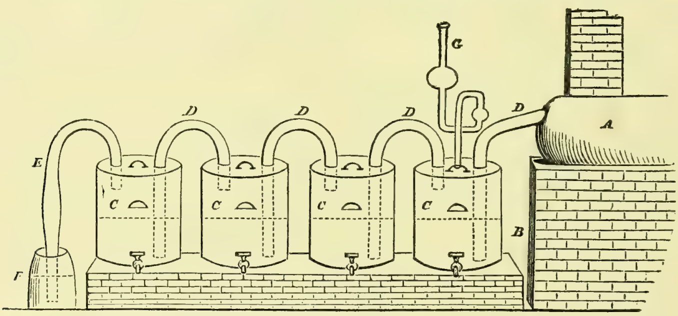
For laboratory purposes liquor-ammonia may be prepared by means of the apparatus represented in the subjoined engraving. A mixture of slaked lime and sal-ammoniac, prepared in the same way as for anhydrous ammonia, is gently heated in the retort, the evolved ammonia being absorbed in the series of Woulff's bottles as shown. The object of the bulb-tubes is to prevent the water being sucked back into the retort, should the stream of gas slacken. The lower part of each tube contains a small quantity of water, which forms an effectual trap, easily allowing air to pass from the outside inwards, but preventing gas from passing in the opposite direction (see SAFETY-TUBE). An arrangement which is quite as effectual and much simpler is to use Woulff's bottles having three necks, the centre one being fitted with a straight tube whose lower end dips below the liquid. Considerable pressure will be required to force the liquid up the tube, but air may easily be drawn in. When the gas is no longer absorbed by the first bottle, the latter should be removed, a fresh one being placed at the other end of the series and the apparatus connected up as before.

If the strongest ammonia be required, the bottles should be kept cool by immersion in water. The gas may be washed with advantage by passing through a small Woulff's bottle containing a little water, before being absorbed in the larger bottles. Any gas which escapes from the last bottle should be either led into a large bulk of water or through a tube into the open air. For



preparing liquor-ammonia on a larger scale from sal-ammoniac, the apparatus represented in fig. 2 may be used.

Comp. Anhydrous ammonia (NH_3) is composed of 1 vol. of nitrogen combined with 3 vols. of hydrogen, the compound gas occupying 2 vols.;



A, Cylindrical Iron Retort.
B, Furnace for ditto.
C C C C, Stoneware Receivers.
D D D D, Connecting Pipes.
E F, Waste Pipe and Receiver.
G, Safety Tube.

or of 14 parts by weight of nitrogen and 3 parts by weight of hydrogen (82·35% nitrogen, 17·65% hydrogen). The composition of ammonia may be shown by enclosing anhydrous ammonia over mercury in a syphon eudiometer, and passing electric sparks through the gas until no further alteration in volume takes place, when the volume of the gas will be found to have doubled. Oxygen is now added in quantity equal to about half the volume of the mixed gases ($N + H_3$), and the mixture exploded. Two thirds of the contraction after explosion will represent the hydrogen originally in the mixture, and from this value the ratio of nitrogen to hydrogen in the mixed gases can be determined. It will be found to be 1 : 3.

Another method consists in enclosing chlorine gas in a cylindrical tube divided into three equal parts, and introducing gradually an excess of liquor-ammonia. On opening the tube under water, the liquid will be seen to rise until the residual gas occupies only one third of the original volume; moreover, this residual gas is found to be nitrogen. Now it is obvious that this nitrogen was originally combined with the hydrogen which has now united with the chlorine to form hydrochloric acid (absorbed by the excess of ammonia); and, since hydrogen and chlorine unite in equal volumes, the hydrogen which has disappeared must have occupied a volume equal to that of the chlorine taken, *i. e.* three times the volume of the residual nitrogen. It is advisable to neutralise the ammonia by opening the tube under dilute sulphuric acid, otherwise the result may be vitiated by vapour of ammonia.

Properties. Ammonia is a colourless gas, possessing a powerfully pungent smell and strong alkaline reaction. Its sp. gr. as compared with that of air is 0·5967. 1 litre of the dry gas at 0° C. and 760 mm. of mercury pressure weighs 0·7635 grm.; 100 cubic in. weigh 18·26 gr.

It can be liquefied by cold and pressure to a colourless mobile liquid of 0·6362 sp. gr. at 0° C., which boils at −33·7° C. under the atmospheric pressure, and solidifies at −75° to a white crystalline solid. The following are the vapour-tensions of the liquid at different temperatures:

At	− 33·7° C. =	1 atmosphere.
,,	− 5° C. =	4 atmospheres.
,,	0° C. =	4·8 ,,
,,	+ 10° C. =	6·5 ,,
,,	+ 20° C. =	8·8 ,,

Its critical temperature (130° C.) is above the ordinary temperature, and it has been used with

advantage in the construction of freezing machines, the simplest of which is Carré's (which *see*).

Ammonia will not support combustion, but burns feebly in air and readily in oxygen, yielding nitrogen and aqueous vapour with traces of nitric acid and ammonium nitrate.

It decomposes at about 500° C., the rapidity of decomposition depending upon the amount of heated surface it comes in contact with, and also upon the nature of the latter. Iron decomposes the gas very rapidly, whilst glass has but little effect. The gas is also decomposed by the electric discharge (see *above*). The decomposition is never complete in either case, probably because a slight recombination takes place under the same agencies. See DISSOCIATION; GASES.

Dry ammonia is absorbed by the chlorides of silver, calcium, and zinc, to be again expelled by the application of heat. If these double compounds be heated in a confined space, such as a thick-walled glass tube, one end of which is kept cool, the evolved ammonia will be liquefied by its own pressure. It was by this device that Faraday first liquefied ammonia in his classical researches on the liquefaction of gases. Ammonia is abstracted from its aqueous solution, and from its salts by clayey soil, but not by pure kaolin. See NITRIFICATION.

Ammonia is absorbed with great avidity by water and alcohol. 1 grm. of water absorbs the following quantities of dry ammonia at 760 mm. pressure and at the temperatures mentioned:

1 grm. water at 0° C. absorbs 0·899 grm. NH_3.
„ „ 10° C. „ 0·679 „ „
„ „ 20° C. „ 0·526 „ „
„ „ 30° C. „ 0·403 „ „
„ „ 100° C. „ 0·074 „ „

At ordinary temperatures the absorption does not follow the law of Henry and Dalton, the quantity absorbed not being proportional to the pressure. As the temperature rises, the absorption approximates more and more to the above law. The following table, due to Carius, gives the percentage composition and sp. gr. of solutions of ammonia for a temperature of 14° C. (57·2° F.).

NH_3.	Sp. gr.	NH_3.	Sp. gr.
Per cent.		Per cent.	
36·0	0·8844	32·8	·8911
35·8	·8848	32·6	·8916
35·6	·8852	32·4	·8920
35·4	·8856	32·2	·8925
35·2	·8860	32·0	·8929
35·0	·8864	31·8	·8934
34·8	·8868	31·6	·8938
34·6	·8872	31·4	·8943
34·4	·8877	31·2	·8948
34·2	·8881	31·0	·8953
34·0	·8885	30·8	·8957
33·8	·8889	30·6	·8962
33·6	·8894	30·4	·8967
33·4	·8898	30·2	·8971
33·2	·8903	30·0	·8976
33·0	·8907	29·8	·8981

NH_3.	Sp. gr.	NH_3.	Sp. gr.
Per cent.		Per cent.	
29·6	·8986	16·8	·9353
29·4	·8991	16·6	·9360
29·2	·8996	16·4	·9366
29·0	·9001	16·2	·9373
28·8	·9006	16·0	·9380
28·6	·9011	15·8	·9386
28·4	·9016	15·6	·9393
28·2	·9021	15·4	·9400
28·0	·9026	15·2	·9407
27·8	·9031	15·0	·9414
27·6	·9036	14·8	·9420
27·4	·9041	14·6	·9427
27·2	·9047	14·4	·9434
27·0	·9052	14·2	·9441
26·8	·9057	14·0	·9449
26·6	·9063	13·8	·9456
26·4	·9068	13·6	·9463
26·2	·9073	13·4	·9470
26·0	·9078	13·2	·9477
25·8	·9083	13·0	·9484
25·6	·9086	12·8	·9491
25·4	·9094	12·6	·9498
25·2	·9100	12·4	·9505
25·0	·9106	12·2	·9512
24·8	·9111	12·0	·9520
24·6	·9116	11·8	·9527
24·4	·9122	11·6	·9534
24·2	·9127	11·4	·9542
24·0	·9133	11·2	·9549
23·8	·9139	11·0	·9555
23·6	·9145	10·8	·9563
23·4	·9150	10·6	·9571
23·2	·9156	10·4	·9578
23·0	·9162	10·2	·9586
22·8	·9168	10·0	·9593
22·6	·9174	9·8	·9601
22·4	·9180	9·6	·9608
22·2	·9185	9·4	·9616
22·0	·9191	9·2	·9623
21·8	·9197	9·0	·9631
21·6	·9203	8·8	·9639
21·4	·9209	8·6	·9647
21·2	·9215	8·4	·9654
21·0	·9221	8·2	·9662
20·8	·9227	8·0	·9670
20·6	·9233	7·8	·9677
20·4	·9239	7·6	·9685
20·2	·9245	7·4	·9693
20·0	·9251	7·2	·9701
19·8	·9257	7·0	·9709
19·6	·9264	6·8	·9717
19·4	·9271	6·6	·9725
19·2	·9277	6·4	·9733
19·0	·9283	6·2	·9741
18·8	·9289	6·0	·9749
18·6	·9296	5·8	·9757
18·4	·9302	5·6	·9765
18·2	·9308	5·4	·9773
18·0	·9314	5·2	·9781
17·8	·9321	5·0	·9790
17·6	·9327	4·8	·9799
17·4	·9333	4·6	·9807
17·2	·9340	4·4	·9815
17·0	·9347	4·2	·9823

NH_3.	Sp. gr.	NH_3.	Sp. gr.
Per cent.		Per cent.	
4·0	·9831	2·0	·9915
3·8	·9839	1·8	·9924
3·6	·9847	1·6	·9932
3·4	·9855	1·4	·9941
3·2	·9863	1·2	·9950
3·0	·9873	1·0	·9959
2·8	·9882	0·8	·9967
2·6	·9890	0·6	·9975
2·4	·9899	0·4	·9983
2·2	·9907	0·2	·9991

The strongest liquor-ammonia has a sp. gr. of ·875, and contains about 39% of ammonia (NH_3); but the usual sp. gr. of the strong ammonia of commerce is ·88. The *liquor ammonia fortior* B.P., has a sp. gr. of about ·891, and contains 32·5%; while the *liquor ammoniæ*, B.P., has a sp. gr. of about ·959 and contains about 10%.

Ammonia solution is frequently looked upon as a hydrate of the radicle, NH_4, and is generally written $(NH_4)OH$, its chemical behaviour being in accordance with this hypothesis. The thermo-chemical researches of Julius Thomsen have, however, failed to find any indication of true chemical combination here.

Tests for; estimation of. Ammonia can be recognised by its pungent odour and by its action on litmus paper. When in combination it may be liberated by heating with caustic soda solution, or better (since urea and some other nitrogenous organic compounds are decomposed by this reagent with evolution of ammonia), by mixing with soda-lime and moistening with water, ammonia being evolved. In minute quantity it may be detected and estimated by means of Nessler's solution. See WATER-ANALYSIS.

Platinum tetra-chloride, $PtCl_4$, added to a strong solution of ammonia which has been neutralised by hydrochloric acid, gives golden-yellow octahedral crystals of the double salt, $(NH_4Cl)_2,PtCl_4$, which are sparingly soluble in water, and insoluble in alcohol. With mercurous salts ammonia gives a black precipitate. Concentrated hydrochloric acid produces dense white fumes of ammonium chloride when brought near to a strong solution of ammonia.

In pure aqueous solutions ammonia may be estimated by determining its specific gravity, preferably by means of the sp. gr. bottle, the corresponding percentage being obtained from the above table. If the value found does not occur in the tables, the corresponding percentage may be arrived at by the method of differences (see ALCOHOLOMETRY). Care should be taken to bring the liquid to the temperature for which the tables are constructed (14° C.). When other substances are present, or when the percentage of ammonia is small, it is best estimated by distilling the liquid into excess of standard hydrochloric or sulphuric acid, and determining the excess of acid by means of standard alkali (see ALKALIMETRY). When in combination, caustic alkali in excess is added to the liquid before distillation, and, should nitrogenous organic matter be present, magnesia.

Ammonia is weighed as chloride, or as the double chloride of ammonium and platinum. These present no certain advantages over the volumetric methods. The first may be useful in the estimation of ammonium sulphide. For this purpose the liquid is acidulated with hydrochloric acid, care being taken that no portions of it are carried away by the escaping gas. The solution is heated and then filtered to remove sulphur, the clear liquid evaporated over the water-bath, and the residue weighed. Or the chlorine may be estimated (after evaporation and re-solution) by means of a standard solution of silver nitrate. The details for precipitating and weighing the double chloride of ammonium and platinum are the same as those for the corresponding potassium salts. See POTASSIUM).

For the estimation of ammonia from nitrogen evolved on treatment with bromised solution of hypochlorite of soda, see ANALYSIS OF SOILS.

Ammonia, Carbonate of. (B.P.) *Syn.* AMMONIÆ CARBONAS. See AMMONIUM, SESQUICARBONATE OF.

AMMONI'ACAL. [Eng., Fr.] *Syn.* AMMONIACA'LIS, L. Pertaining to, or possessing the odour or properties of, ammonia. See AMMONIA, &c.

AMMONI'ACUM. *Syn.* GUM AMMONIACUM, G. AMMO''NIAC†; GOMME AMMONIAQUE, Fr.; AMMONIAK, Ger. Ammoniacum gum, obtained from *Dorema ammoniacum*, Don., a large herbaceous plant, found in South-west and Northern Persia and Khorassan. It contains an abundant milky juice, which exudes upon the slightest puncture, and dried by exposure to the air constitutes ammoniacum of commerce. It is, however, chiefly collected from the stem, the exudation being caused by the puncture of beetles. For commercial purposes ammoniacum appears to be collected solely in Persia, and is obtained almost entirely by way of Bombay, where it arrives in bales often mixed with large quantities of extraneous matter, from which it is sorted and sent to the various markets. Ammoniacum occurs in tears of a yellowish straw colour, or in lumps, the tears becoming agglutinated by pressure or heat, It is a powerful stimulating expectorant, and valuable in chronic bronchitis and other pulmonary affections. Externally it is applied as a local irritant. Ammoniacum is, however, not so much used as formerly; it has a strong alliaceous smell, a nauseous and slightly bitter taste.

Dorema root is imported into Bombay from Persia in large quantities, and used as incense in the Parsee fire temples. It "was some years ago exported to Europe as Bombay sumbul, after having been cut up and impregnated with musk." When old or worm-eaten it becomes spongy, and might be mistaken for sumbul.

The ammoniacum here referred to is not that of Hippocrates, Dioscorides, and Pliny, which was used for fumigation and was derived from Africa. The last forms an article of trade between Egypt and Arabia, and is furnished by a species of *Elæoselinum*.

A gum resin very similar to the ammoniacum, of commerce is furnished by *Dorema Aucheri*, Boiss., a plant widely distributed in the western provinces of Persia and the neighbourhood of Ispahan.

Doses for Animals. HORSE, 2 to 4 dr. CATTLE, 2 to 4 dr. SHEEP, ½ to 1½ dr. PIG, ½ to 1½ dr. DOG, 10 to 20 gr. Either by bolus or emulsion.

Ammoniacum, Strained. *Syn.* PREPARED AMMONIACUM; AMMONI'ACUM PRÆPARA'TUM (Ph. L.), L. *Prep.* (Ph. L. 1851.) Boil ammoniacum in water just sufficient to cover it; strain the mixture through a hair sieve, and constantly stirring, evaporate in a water bath, until, on cooling, it becomes hard. The product, owing to a loss of volatile oil, is much weaker than the unprepared gum-resin. The process is only necessary with rough lump ammoniacum.

AMMO''NIATED. *Syn.* AMMONIA'TUS, L. In *pharmacy, perfumery*, &c., applied to preparations containing ammonia.

AMMO'NIO-. In *chemistry*, a common prefix to double salts containing ammonia; as ammonio-citrate, a.-chloride, or a.-tartrate of iron, &c. See the respective metals.

AMMONIUM. The name given to a group of atoms (NH_4) which play the part of a compound basic radicle, or metallic element. For the elucidation of the ammonium theory we cannot do better than quote from Roscoe and Schorlemmer's 'Chemistry,' vol. ii, p. 173.

"The name VOLATILE ALKALI was long given to ammonia, as pointing out its similarity to the fixed alkalies, potash and soda. In 1808, Seebeck made the interesting discovery that when mercury is brought into a strong aqueous solution of ammonia, and an electric current is passed through it, the metal increases rapidly in bulk, giving rise to an amalgam-like mass. The same observation was made almost simultaneously by Berzelius and Pontin, whilst Davy, as soon as he was informed of the fact, repeated the experiment and discovered that a piece of sal-ammoniac moistened with water might be employed instead of aqueous ammonia. Davy also noticed that the same amalgam-like mass is formed when an amalgam of potassium is thrown into a concentrated solution of sal-ammoniac. Hence he, like Berzelius, came to the conclusion that ammonia must contain oxygen, and that in this experiment it, like potash and soda, had been reduced by the electricity to a metal-like body. To this metal-like substance, which was supposed to exist in this amalgam, they gave the name AMMONIUM. This view of the constitution of the ammonium compounds was objected to by Gay-Lussac and Thénard, who, from their experiments on the subject, carried out in the year 1809, concluded that the formation of the amalgam is due to a combination of the ammonia with hydrogen. They arrived at this result from observing that the amalgam undergoes rapid spontaneous decomposition into mercury, ammonia, and hydrogen gas. Arguing from analogy, the French philosophers were inclined to believe that in like manner potassium and sodium could not be considered to be true metals, but were rather the hydrogen compounds of the alkalies. In reply to their objections, Davy and Berzelius showed that the hydrogen which was evolved arose from the decomposing action of the metallic ammonium upon the water which adhered to it, in the same way as when sodium and potassium are thrown into water, hydrogen is evolved. Berzelius continued to hold the view that oxygen is contained in ammonia, and he explained the fact that this element could not be detected in the ammonia, by assuming that nitrogen itself is an oxide of an element hitherto not isolated, to which he gave the name of NITRICUM. Ampère was the first, in the year 1816, to endeavour to explain the analogy of the ammonium salts with those of the fixed alkalies. He showed that the differences in composition between the salts of a fixed and those of the volatile alkali disappear when we assume that, in the latter class of salts, a compound radicle exists composed of 1 vol. of nitrogen to 4 vols. of hydrogen; so that sal-ammoniac or hydrochloride of ammonia may be regarded as the chloride of a metal-like substance to which the name of AMMONIUM had been given. In 1820, Berzelius gave up his old view and accepted the ammonium theory. He allowed that aqueous ammonia must be regarded as a solution of ammonium oxide, and assumed that when anhydrous ammonia unites with a hydrogen acid (a substance to which we now give the simple name of acid), the ammonia combines with the hydrogen of the acid to form the metal-like radical ammonium, and that this becomes an oxide by union with the oxygen of the water."

Ammonium Salts. The ammonium salts are accordingly looked upon as compounds of the group NH_4 with acid radicles. Thus ammonium chloride is $(NH_4)Cl$. The ammonium salts are isomorphous with those of potassium. For tests, see AMMONIA.

Ammonium salts are decomposed when heated. If the acid is not volatile, as in ammonium phosphate, ammonia is given off and phosphoric acid left behind; if the acid is volatile, as in ammonium chloride, the salt will sublime unchanged. A dissociation does however occur, the vapour density corresponding with that of $(NH_3 + HCl)$, and not with that of NH_4Cl. If ammonium chloride vapour be allowed to diffuse through a porous substance, the ammonia will diffuse more quickly than the hydrochloric acid gas, and may be recognised by its action on litmus paper.

Ammonium, Acetate of. $NH_4C_2H_3O_2$. *Syn.* AMMO''NII ACE'TAS, L.; ACETATE D'AMMONIAQUE, Fr.; ESSIGSÄURES AMMONIAK, Ger. *Prep.* 1. Take of acetate of lime or of potash and sal-ammoniac, equal parts; mix and distil at a gentle heat. The oily liquid [BINACETATE OF AMMONIUM, $HNH_4(C_2H_3O_2)_2$] in the receiver forms a radiated crystalline mass on cooling. Dry gaseous ammonia passed into this salt, melted by a gentle heat, transforms it into the solid and inodorous neutral acetate, $NH_4C_2H_3O_2$.

2. Strong acetic acid is saturated with ammonia or carbonate of ammonium, and the solution evaporated over sulphuric acid *in vacuo*; the resulting crystals, after being carefully drained, are dried by pressure between bibulous paper.

Prop., &c. Long, slender crystals, or a crystalline mass, freely soluble both in alcohol and water, and deliquescent in the air; taste sharp and cooling, and somewhat sweetish. Its solutions cannot be evaporated without loss of the ammonia; even the salt passes off in large quan-

tities with the vapour of water. Its aqueous solution becomes alkaline on keeping, from decomposition of the acid. Distilled with anhydrous phosphoric acid, it is converted into acetonitrile (CH_3CN). An aqueous solution of this salt was introduced into the Materia Medica by Boerhaave, and has since been extensively used as a diaphoretic and febrifuge, under the popular name of MINDERERUS SPIRIT, after Minderer or Mindererus, who employed it extensively and extolled its virtues. When pure, both the salt and its solutions are neutral to test-papers, and are wholly volatilised by heat. See SOLUTIONS.

Ammonium, Arseniate of. $(NH_4)_3AsO_4$. *Syn.* AMMONII ARSE'NIAS, L. *Prep.* 1. (NEUTRAL.) Saturate a warm concentrated solution of arsenic acid with carbonate of ammonium in slight excess, and evaporate by a gentle heat, so that crystals may form on cooling.

2. **Ammonium, Binarseniate of.** $H(NH_4)_2AsO_4$. Prepared as above, but adding an additional equivalent of the acid, as soon as any excess of ammonia has been expelled by the heat employed to evaporate the solution.—*Dose* (of either) 1-24th to 1-12th gr.; in phthisis, certain skin diseases, &c. See SOLUTIONS (also *below*).

Ammonium, Arsenite of. NH_4AsO_2. *Syn.* AMMONII AR'SENIS, L. *Prep.* From a hot concentrated solution of arsenious acid and sesquicarbonate of ammonium, as the last. Used (chiefly) to make arsenite of iron. The properties and physiological effects of the above arsenical preparations are for the most part similar to those of arseniate and arsenite of potash. They are all poisonous.

Ammonium, Benzoate of. $NH_4C_7H_5O_2$. *Syn.* AMMONII BENZOAS. *Prep.* 1. Dissolve benzoic acid in ammonia solution to saturation, then further add ammonia in slight excess, and crystallise by refrigeration, or *in vacuo.*

2. The process of the B.P. is as follows:—Take of solution of ammonia 3 oz. or a sufficiency, benzoic acid 2 oz., distilled water 4 oz. Dissolve the benzoic acid in 3 oz. solution of ammonia previously mixed with the water, evaporate, keeping ammonia in slight excess, and set aside that crystals may form.

Prop., &c. Colourless laminar crystals; ignited, they burn with a smoky flame, leaving no residue. Very soluble in water and alcohol, the solutions giving a buff-coloured precipitate with ferric chloride, and a white crystalline precipitate of benzoic acid with mineral acids. Employed medicinally as a stimulating expectorant and diuretic, useful in old coughs and bronchitis. Employed to render the urine acid where there is a tendency to phosphatic deposits.—*Dose,* 10 to 20 gr.

Ammonium, Bromide of. NH_4Br. *Syn.* AMMO''NII BROMI'DUM, A. BRO'MIS, L.; HYDROBROMATE D'AMMONIAQUE, BROMURE D'AMMONIUM, Fr. A salt which is obtained from hydrobromic acid, bromide of iron, &c., by similar processes to those adopted for the iodide. The following process for the preparation of bromide of ammonium is from the formula for the new medicaments adopted by the Paris Pharmaceutical Society: "Add bromine very slowly to a solution of ammonia, with continual stirring, until the liquid remains faintly and persistently coloured by a slight excess of bromine."

Prop., &c. Colourless crystals which may become slightly yellow by exposure to air. Heat sublimes it unchanged. Freely soluble in water, less soluble in spirit. Gives no immediate yellow colour when moistened with dilute sulphuric acid (absence of iodides).

Used as a nervine sedative in hysteria; especially useful for sleeplessness where there is no organic disease; given in epilepsy when bromide of potassium fails.—*Dose,* 2 to 20 gr.

Ammonium, Carbonates of. These are compounds of ammonia, carbonic anhydride, and water in different proportions. They only exist at low temperatures, since at 58°—60° C. dissociation begins, and the salts are ultimately decomposed into the above gases.

Neutral Salt, $(NH_4)_2,CO_3 + H_2O$. Lengthened plates. Deliquesces in the air, losing ammonia and water, and forming an acid salt. Tastes and smells of ammonia. Recrystallises from water unchanged. The aqueous solution boils at 75°—80° C., ammonia and carbonic anhydride being given off in the proportion in which they exist in the salt.

Semi-acid Salt, $(NH_4)_4,H_2(CO_3)_3,H_2O$. Hexagonal plates. Smells and tastes of ammonia; dissolves unchanged; decomposes on heating.

Acid Salt $(NH_4),HCO_3$ (ammonium bicarbonate). Occurs in guano beds, and sometimes in gas-pipes, &c.; probably exists in crude gas-liquor. This salt is always formed when other ammonium carbonates effloresce, and 'commercial' ammonium carbonate sometimes consists of little else. Best prepared by introducing aqueous vapour and ammonia into carbonic anhydride in a warm condenser (*Divers*). The following methods are used when the salt is required in quantity.

a. Sesquicarbonate of ammonia is digested in a considerable excess of cold water until the whole of the pungent neutral carbonate is dissolved out. If the salt is reduced to powder, the operation is facilitated.

b. To powdered sesquicarbonate of ammonia add boiling water just sufficient to dissolve it, and immediately close the vessel; crystals containing 2½ equivalents of water form as the liquid cools.

Prop., &c. This salt is for the most part similar to the sesquicarbonate. It has a cool and saline taste; its taste and smell being only faintly ammoniacal, it is more palatable than the sesquisalt. It crystallises in oblique prisms, which, as usually obtained, contain about 23% of water. 100 parts of water dissolve:

At 10° C.	. .	15·8 parts.
„ 15° C.	. .	18·3 „
„ 20° C.	. .	21·0 „
„ 25° C.	. .	23·9 „
„ 30° C.	. .	27·0 „

It is distinguished from the previous carbonates by the almost entire absence of ammoniacal odour, and by its solution giving no immediate precipitate with chloride of barium; but on standing, or on the addition of a little ammonia solution, a white earthy precipitate is formed, accompanied with the evolution of carbonic acid gas. A saturated solution of this salt, evaporated by a very gentle

heat, or refrigerated, gives small prismatic crystals having neither smell nor taste.

It does not decompose when dry, but breaks up at 60° into carbon dioxide, ammonia and water. In solution it loses carbonic anhydride, especially when heated.

Uses, &c. Inhaled, it prevents drowsiness or fainting, or recovers persons from a faint. In large doses it is an emetic; in small doses it is a stimulant and expectorant, and it may be used in bronchitis, when the tubes are choked with mucus. Useful as a substitute for alcohol, when a craving for stimulants is felt. In scarlet fever it is considered almost a specific; dose as a stimulant 3 to 10 grs., as an emetic 30 grs.; does not decompose when dry, but breaks up at 60° into CO_2NH_3 and H_2O. In solution it loses carbonic anhydride, especially when heated.

Ammonium Carbamate $CO\langle{}^{NH_2}_{ONH_4}$ (see AMIDO-ACIDS). This salt was formerly called dry ammonium carbonate. It is always formed when ammonia gas and carbonic anhydride are brought together, and also in the presence of moisture provided there is an excess of ammonia; hence it is always a constituent of commercial ammonium carbonate, and can be prepared from the latter by slow distillation. It is deliquescent, smells of ammonia, and volatilises almost completely. At 60° C. it is decomposed into its constituents. It dissolves in 1½ parts of water with considerable evolution of heat, and quickly loses ammonia, changing into the acid carbonate.

Commercial Ammonium Carbonate. *Syn.* (CARBONATE OF AMMONIUM, AMMONIÆ CARBONAS, B.P.) CARBONATE D'AMMONIAQUE, Fr.; KOHLENSÄURES AMMONIAK, Ger. Also called SESQUICARBONATE OF AMMONIA, SALT OF HARTSHORN, SAL-VOLATILE.

A mixture of bicarbonate of ammonium and ammonium carbamate with a little water. Formed when carbonic anhydride (even in excess) and ammonia are brought together in presence of the necessary amount of moisture. It was formerly supposed to be formed when any one of the ammonium carbonates, or a mixture of sal-ammoniac and chalk is quickly distilled. Divers, however, has shown that the neutral carbonate is formed, the conversion into 'commercial' carbonate occurring in the subsequent re-sublimation. As at present manufactured it is richer in ammonia than formerly, and approximates to the formula: $(NH_4)HCO_3,CO(NH_2)(ONH_4)$ = 32·48% NH_3, 56·05% CO_2, and 11·47% H_2O. It effloresces in the air, losing 47% by weight and leaving the bicarbonate. The same decomposition is effected by washing the salt with a small quantity of water. It dissolves in 4 parts of water at 15° C., in 1½ at 65° C. At 75° C. its solution gives off much carbonic anhydride, and at 85° C. ammonia begins to come off. At 100° C. the salt volatilises with the steam.

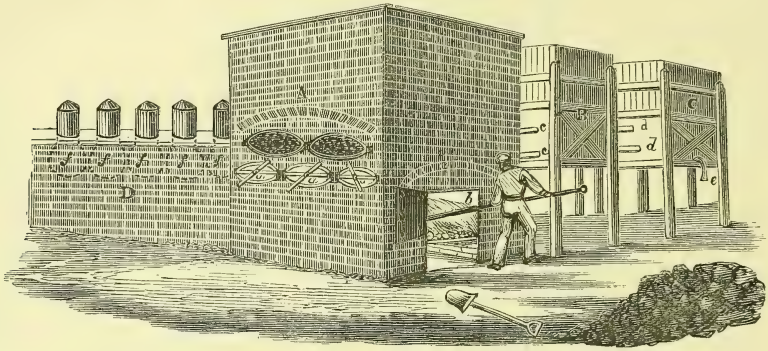
According to Lunge, carbonates with 25% and 30% of ammonia are made in Germany. Their value as baking-powders is about the same. The acid carbonate (21% NH_3) is not made in very large quantity. The same authority gives the following table of specific gravities for solutions of commercial ammonium carbonate (of 31·3% NH_3, 56·6% CO_2, 12·1% H_2O). The temperature for which the tables are constructed is 15° C. The factors appended are used as follows:—Suppose sp. gr. to be 1·108 at 19° C., then sp. gr. at 15° C. = 1·108 + 0·0007 (19—15) = 1·1108 = 33·71% ammonium carbonate.

Degrees, Twaddell.	Sp. gr. at 15°.	Per cent. Ammon. Carb.	Sp. gr. Factor for 1° C.
1	1·005	1·66	0·0002
2	1·010	3·18	0·0002
3	1·015	4·60	0·0003
4	1·020	6·04	0·0003
5	1·025	7·49	0·0003
6	1·030	8·93	0·0004
7	1·035	10·35	0·0004
8	1·040	11·86	0·0004
9	1·045	13·36	0·0005
10	1·050	14·83	0·0005
11	1·055	16·16	0·0005
12	1·060	17·70	0·0005
13	1·065	19·18	0·0005
14	1·070	20·70	0·0005
15	1·075	22·25	0·0006
16	1·080	23·78	0·0006
17	1·085	25·31	0·0006
18	1·090	26·82	0·0007
19	1·095	28·33	0·0007
20	1·100	29·93	0·0007
21	1 105	31·77	0·0007
22	1·110	33·45	0·0007
23	1·115	35·08	0·0007
24	1·120	36·88	0·0007
25	1·125	38·71	0·0007
26	1·130	40·34	0 0007
27	1·135	42·20	0·0007
28	1·140	44·29	0·0007
	1·1414	44·90	0·0007

For further information on the ammonium carbonates, see Divers, 'Journal of the Chemical Society,' 1870, vol. viii, p. 171.

Manufacture. Ammonium carbonate is formed in the destructive distillation of animal matter, and, if the latter is dry, is found in the receiver as brown crusts, formerly known as 'salts of hartshorn'; the aqueous part of the distillate, consisting of a saturated solution of ammonium carbonate, was known as 'spirits of hartshorn.' This manufacture is no longer carried out, ammonium carbonate being now prepared by distilling a mixture of calcium carbonate (chalk) and ammonium sulphate. The distillation is usually carried on in cast-iron retorts, similar in size, shape, and character to those employed in the manufacture of coal-gas, and of which five, or more, are commonly set horizontally on the same furnace (see *engr.*). Each retort has its mouth (*a*), through which the 'charge' is introduced, closed with a moveable door, which is securely fastened in its place, in the manner shown in the figure; and it is furnished, at the upper part of its further end, with an iron pipe (*c*), to carry off the evolved vapours to the condenser or receiver. The latter consists of two large square wooden chambers (*B*, *C*), lined with lead, and either fitted with moveable covers, secured by water-joints, or with

doors in the side, to permit of the easy removal of the sublimed salt. The first receiver communicates with the second by means of a large leaden tube (*d*) near its centre, and by another tube (*d′*), somewhat smaller, and nearer the bottom, but above the surface of the stratum of water in the second receiver, before alluded to. These chambers have also a leaden pipe (*e*, *e*), stopped during the process with a plug or cock of lead, to allow of the liquid product of the distillation, &c., being drawn off, or run into another receiver or cistern, at will. Both chambers are placed on strong wooden supports, or scaffolding, to bring them on a level with the retorts. When the impure sulphate or other ammonia-salt is used in the manufacture of the sesquicarbonate (which is



generally the case), the resulting salt being impure and discoloured is re-sublimed in iron pots (*f*, *f*, *f*), furnished with moveable leaden heads, which are kept cool by a current of air passing over them. A little water is introduced into the subliming pots to render the product translucent. The heat is applied either by means of a flue passing from the retort furnace (*A*, *b*), or by a water-bath heated in the same manner; the latter is the preferable method, as the temperature should not be greater than about 90° C. (200° F.), and need not exceed 63°—64° C. (150°—155° F.). These pots are arranged in sets, as shown at *D* in the engraving.

The charge of a retort usually consists of about 70 to 72 *lbs.* of sulphate of ammonia, or 57 to 58 *lbs.* of the chloride, to 1 *cwt.* of chalk; or at least of the materials in these proportions. The product is about 40 *lbs.* of the crude salt, which, by careful resublimation, yields about 39 *lbs.* of marketable carbonate of ammonia.

Dr Lunge remarks that the process of making ammonium carbonate is not quite rational, seeing that the finished article contains 1½ times as much carbonic anhydride as the neutral salt, whilst the conditions of the reaction are such as to give theoretically the latter only. There must evidently, therefore, be a considerable loss of ammonia in some part of the process, probably in the resublimation, and he suggests passing carbonic anhydride into the subliming apparatus. In a later edition Dr Lunge states that this modification has been carried out with success.

The more recent processes for the manufacture of ammonium carbonate consist mainly in distilling crude ammonia liquor over limestone or dolomite, and removing any ammonium sulphide from the condensed liquid by means of carbonic anhydride.

Prop. and Tests for. Pure ammonium carbonate should be quite white, and at a fresh fracture transparent. It soon becomes covered with a powdery layer of bicarbonate when exposed to the air. It should be free from tarry matters, which will cause its solution to have a brown colour, and should volatilise when heated, without leaving any residue. When required for analysis, its solution, after neutralisation with pure nitric acid, should give no precipitate with silver nitrate or barium chloride. Lime may be tested for by adding ammonium oxalate, and lead (which should be entirely absent when the salt is for the use of bakers) by means of sulphuretted hydrogen. Sometimes thiosulphate is present, and may be recognised by adding silver nitrate to an acetic acid solution, when a white precipitate, rapidly turning brown is produced.

Uses, &c. It is chiefly used for scouring wool; by bakers to give lightness to their bread; in dyeing; as a general detergent; as smelling-salts; by the chemist and pharmaceutist, for the preparation of other salts of ammonia; and in analysis. In *medicine*, inhaled, it prevents drowsiness or fainting, or recovers persons from a faint. In large doses it is an emetic; in small doses it is a stimulant and expectorant, and may be used in bronchitis, when the tubes are choked with mucus. Useful as a substitute for alcohol, when a craving for stimulants is felt. In scarlet fever it is considered almost a specific; dose as a stimulant 3 to 10 grs., as an emetic 30 grs.; does not decompose when dry, but breaks up at 60° into CO_2,NH_3 and H_2O. In solution it loses carbonic anhydride, especially when heated.

Ammonium, Bicarbonate of. See AMMONIUM CARBONATES, ACID SALT.

Ammonium, Chloride of. NH_4Cl. *Syn.* MURIATE OF AMMONIA, SAL-AMMONIAC, HYDROCHLORATE OF AMMONIA; CHLORHYDRATE D'AMMONIAQUE, SEL-AMMONIAC, &c., Fr.; SALMIAK, Ger.

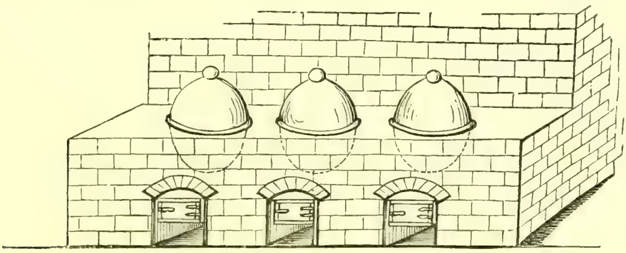
This salt is prepared in a manner exactly similar to that employed for the manufacture of crude ammonium sulphate, already described under the working up of gas-liquor. As in the case of the sulphate, the crude ammonia vapour is

passed into a saturator containing in this case hydrochloric acid, the evolved gases being disposed of as before. The liquor is then evaporated to the crystallising point, and the crude ammonium chloride purified by sublimation. The following are the details:

The EVAPORATION of the crude saline solution is usually carried on in large square or rectangular cast-iron vats, of very moderate depth, and capable of holding from 1000 to 1500 gallons, or more. These are encased in brickwork, and are heated by a furnace, of which the flues pass in a sinuous course beneath the lining of brickwork on which the vats or pans rest. During the concentration of the liquid, the tar, &c., which separates and floats on the surface, and which thus seriously impedes evaporation, is from time to time removed by skimming. As soon as the sp. gr. reaches 1·25, any excess of acid in the solution is exactly neutralised with a little fresh ammoniacal liquor, waste of acid being thus prevented; at the same time any ferric salt present, which would contaminate the ultimate product, is precipitated as sesquioxide. After settling for a short time, the hot liquor is ready to be transferred to the crystallisers.

The vessels employed in the CRYSTALLISATION are pans or tubs, usually circular and about 7 or 8 ft. wide, by 2½ to 3 ft. deep; these are generally set on the ground, or are embedded either partially or wholly in it. The saline liquor, being pumped or run into them at a little below the boiling temperature, crystallises as it cools, the only interference being occasional stirring or agitation, to prevent the formation of large crystals, which would be inconvenient in the subsequent part of the process. The time occupied in the crystallisation varies according to the size of the 'crystallisers,' and according to the state of the weather, from 3 or 4 to 8 or even 10 days. The 'mother-liquor' of the 'crystallisers' is pumped back into the evaporating pans for further concentration. The crude blackish salt (chloride) thus obtained is contaminated with tarry and oleaginous matter, free acid, water, &c., from part of which it is freed by exposing it in a layer about 4 in. deep, on a cast-iron plate gently heated by a zigzag flue of a small furnace, until all the water is expelled. Care must be taken that the temperature never rises high enough to volatilise the salt. This operation is generally performed under a dome, or the expanded throat of a large chimney. The salt will by this time have become of a greyish-white colour, and is now ready for the next operation.

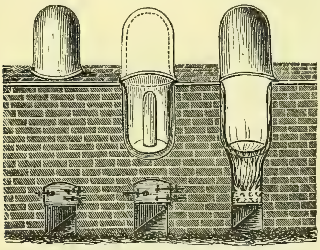
The crude dried salt of the last process is finally purified by sublimation. For this purpose cast-iron pots lined with clay, and heated from below and by flues round their sides, are employed (see *engr.*). The crude grey salt is beaten down into these pots until they are about two thirds filled, when the heads or capitols are fitted on, and heat applied. The latter are very heavy, being usually made of lead (sometimes of iron), and have the form of a dome or a hemispherical cup, with a small tube or hole at the apex, in which a plug is loosely placed, to permit the escape of steam. These domes or heads are so made as to fit closely and firmly on the flat rim or flange of the 'sublimers;' and are retained in their places, during use, both by their weight and by 2 or 3 clamps provided for the purpose. They are also furnished with 3 rings, set at equal distances, to allow of their being lifted off, or moved, by means of a pulley and chains. The due application and regulation of the heat is here of the utmost importance. If the



temperature employed be too high, the sublimed salt will be contaminated with empyreumatic matter, while some of it will be carried beyond the dome and lost; and if it be extreme, the head may be blown off altogether, and the contents of the pan scattered about the building; whilst on the other hand, if the temperature employed be too low, the resulting cake of sal-ammoniac will be soft, spongy, and either grey or yellowish. The proper temperature is said to be known by 2 or 3 drops of water boiling readily, and being dissipated in vapour, when placed on the head or cover of the sublimer; but it should not 'spit' or 'dance about,' or be raised by the heat out of contact with the metal. The usual practice is to keep the fires "briskly up until the sublimers and their surroundings attain a sufficient degree of heat; they are then slackened, and maintained at a mean temperature" (*Muspratt*). The sublimation occupies from 5 to 9 days; but it is customary to raise the heads once, or even twice a week, to ascertain the progress made, the fires having been purposely neglected or checked for some hours previously. The process is finally stopped before the whole of the crude salt in the pots is volatilised, otherwise the heat required for that purpose would lead to the decomposition of the carbonaceous impurities, and cause them to emit volatile hydrocarbons, which would materially lessen the purity and beauty of the product. The unsublimed portion in the pots forms a conical mass, which is technically called the 'yolk.' This is shown in the second engr. (see *below*), in which the latest im-

provements in the form of the subliming apparatus are also exhibited.

The sublimation having been carried to a sufficient extent, the fires are allowed to die out. The domes, after cooling, are lifted off, and the attached hemispherical cakes or 'bells' of SAL-AMMONIAC or HYDROCHLORATE OF AMMONIUM at once removed. These vary from 2 to 5 inches in thickness, and from 45 or 50 to 1000 *lbs.*, and upwards, in weight, according to the size of



the sublimers in which they have been produced. They are generally nearly pure, except in the outer part, which has been in contact with the metal. From the subliming-house they are taken to the store or packing-house, and after having been scraped, to remove the discoloured portion before alluded to, are either preserved entire, or are broken up into convenient pieces, which are then packed in casks or barrels, and in either state are ready for the market.

The second part of the above process, viz. the sublimation, is invariably followed in the manufacture of sal-ammoniac, but the saturation part of the process has been subject to modifications, owing to the fact that not even lead is able to withstand for long the action of boiling hydrochloric acid.

The most successful of these consists in preparing the sulphate in the ordinary way, intimately mixing it with an equivalent quantity of common salt, and subliming as before. The residue in the pot then contains sodium sulphate. Another method is to add sodium chloride to a solution of the sulphate and evaporate. Sodium sulphate crystallises out first and is removed, the mother-liquor is then made to crystallise as before, and the ammonium chloride sublimed.

Comp. Ammonium chloride is composed of 1 vol. of ammonia (NH_3) combined with 1 vol. of hydrochloric acid (HCl), or 17 parts by weight of the former to 36·5 parts by weight of the latter (31·78% NH_3, 68·22% HCl).

Prop., &c. The sal-ammoniac of commerce is found under the form of large white hemispherical cup-like cakes or masses (or in large fragments which are sections of them), possessing a tough, fibrous, semi-crystalline texture, and is very difficult to powder; likewise as a fine white granular powder. It is odourless, has a saline taste somewhat sharp or acrid, and sublimes without either fusion or apparent decomposition (see AMMONIUM SALTS). It reddens litmus slightly; dissolves in rather less than 3 parts of cold water, and in about 1 part of boiling water; is soluble in alcohol; and when crystallised from water, under favorable circumstances, forms distinct octahedra or cubes, usually small and aggregated together in rays or feathery masses. By slowly evaporating its aqueous solution, it may be sometimes obtained in cakes an inch in thickness. It is anhydrous. Sp. gr. 1·450.

Pur. It should give a colourless solution with water, sublime completely when heated, and neither chloride of barium nor sulphuretted hydrogen should affect its solution. A solution, to which a few drops of nitric acid have been added, should not yield a blue precipitate with ferrocyanide of potassium. It often contains chloride of iron, and sometimes lead, both of which may be readily detected by the above tests. Its complete volatility may be easily determined by heating, in the flame of a candle, a small fragment held on the point of a knife.

Tests. 1. It is known to be a salt of ammonium by its evolving ammoniacal fumes when triturated with lime, or when moistened with caustic potash or soda solution. 2. It is shown to be a chloride by its solution yielding, with nitrate of silver, a white curdy precipitate, insoluble in boiling nitric acid, soluble in ammonia.

Uses, &c. In the *arts,* chiefly in the coating and soldering of metals, and the preparation of alloys; in dyeing; and in the manufacture of ammonia-alum (also, in large quantities, to give a factitious pungency to snuff). In *chemistry,* as a reagent; and, owing to the cold produced during its solution, to form freezing mixtures.

Chemically pure chloride of ammonium may be prepared by bringing its gaseous constituents—ammonia and hydrochloric acid—into contact. During the combination much heat is generated, and the anhydrous solid salt is precipitated in a minutely divided state, which, under the microscope, is seen to be crystalline. It may be also more easily and conveniently prepared by saturating pure and moderately dilute hydrochloric acid with ammonia or its carbonates, and evaporating the solution until a pellicle forms, when crystals of the chloride separate as the liquid cools. A similar but rather more violent reaction occurs when gaseous chlorine is brought in contact with gaseous ammonia, or is passed into a nearly saturated solution of ammonia or its carbonates, but in this case nitrogen is evolved at the expense of the ammonia; moreover, the process is attended with danger. See NITROGEN COMPOUNDS.

Ammonium, Citrate of. $(NH_4)_2HC_6H_5O_7$. *Syn.* DIAMMONIUM CITRATE, CITRATE OF OXIDE OF AMMONIA; AMMO′NIÆ CIT′RAS, L.

Prep. A concentrated solution of pure citric acid, gently heated, is saturated with carbonate of ammonium, in fine powder (about 7 parts to 6), and slightly in excess; and the resulting liquid is crystallised by refrigeration in close vessels, or by evaporation *in vacuo.* If heat be employed in the evaporation of the solution, an acid citrate will be formed. A solution is official in the B. P. See SOLUTIONS.

Uses, &c. Chiefly as a chemical reagent. An extemporaneous citrate, made with lemon-juice and drank effervescing, is employed as a saline draught and a mild aperient and diaphoretic, in fevers, &c.

Ammonium, Ferrocyanide of. $(NH_4)_4FeC_6N_6 \cdot 3Aq$. *Syn.* FERROCYANATE D'AMMONIAQUE, Fr.

Prep. 1. Saturate a solution of hydro-ferrocyanic acid with sesquicarbonate of ammonium, in slight excess; evaporate the solution at a heat below ebullition, and crystallise by refrigeration.

2. Digest ferrocyanide of lead or of iron in a solution of sesquicarbonate of ammonium, at a gentle heat, for some time; then filter, evaporate, and crystallise.

Prop., &c. It is isomorphous with ferrocyanide of potassium, easily crystallisable, very soluble in water, and is decomposed by ebullition.

Ammonium, Iodide of. NH_4I. *Syn.* HYDRIODATE OF AMMONIA; AMMO′′NII IODI′DUM, L.; HYDRIODATE D'AMMONIAQUE, Fr. *Prep.* An aqueous solution of hydriodic acid is neutralised with ammonia or ammonium sesquicarbonate in slight excess, and the resulting liquid is either carefully, but rapidly, evaporated to dryness over a water-bath, or it is concentrated by the same means, and then caused to deposit crystals by refrigeration. In both cases care is taken to keep a slight excess of ammonia present during the evaporation. The crystals are dried by pressure between folds of bibulous paper, and the product, in either form, preserved in a stoppered bottle.

Pure iodine is triturated with a little distilled water, and solution of ammonium sulphydrate added, in small quantities at a time, with continued trituration, until the red colour of the iodine has entirely disappeared. The solution, after being gently boiled for a few seconds, to expel the sulphuretted hydrogen present, is filtered, rendered slightly alkaline with ammonia, and evaporated or crystallised, as before.

Prop., &c. Colourless, deliquescent, freely soluble in water, and in spirit; air and light turn it yellowish or brownish, with partial decomposition. It closely resembles iodide of potassium, but is more active than the latter, and thought to be better suited to irritable and relaxed habits.—*Dose,* 1 to 10 or 12 gr.

Ammonium, Lac′tate of. *Syn.* AMMO′′NIÆ LAC′TAS, L. An uncrystallisable salt prepared by saturating ammonia, or its carbonate, with lactic acid. It has been found useful in rickets, and in dyspepsia and worms, when occurring in debilitated habits. For this purpose it is best taken fresh-prepared, as a draught, flavoured with syrup of orange-peel, 3 or 4 times daily. See LACTATE and LACTIC ACID.

Ammonium, Nitrate of. NH_4NO_3. *Syn.* AMMO′′NIÆ NI′TRAS, L.; NITRATE D'AMMONIAQUE, Fr. *Prep.* Saturate nitric acid (diluted with 3 or 4 times its weight of water) with carbonate of ammonium, evaporate by a gentle heat, and crystallise. When not required in a crystalline form, it is usually evaporated to dryness at about 100° C. (212° F.); and the heat being carefully raised to about 121° C. (250° F.), the fused salt is poured out on a polished slab of iron or stone, and, when solid, is broken up and put into bottles.

Prop. When the evaporation of the solution is conducted at a temperature under 38° C. (100° F.), the salt is obtained in beautiful hexagonal prisms; when at 100° C., in long silky fibres; when by rapid evaporation and fusion, it forms a white, compact, and usually foliated mass. It dissolves in about twice its weight of water, is slightly deliquescent, melts at 230°, and is decomposed into nitrogen monoxide (N_2O) and water at 238° C. (460° F.) It deflagrates, like nitre, on contact with heated combustible matter.

Uses, &c. Chiefly to prepare nitrous oxide or laughing gas (of which nearly 4½ cubic feet may be procured from every *lb.* avoir.); and with water, to form freezing mixtures, for which purpose it may be used for any number of times by simply evaporating the solution to dryness, when the salt, obtained unaltered, is ready for another operation. Care, however, should be taken not to expose it to too great a heat, as at a certain temperature it decomposes with violence. It is occasionally employed in the laboratory to promote the combustion of organic bodies during incineration; and sometimes, though seldom, in medicine, as a diuretic and diaphoretic. It is said to reduce the frequency of the pulse, and the animal heat, without affecting the head, chest, or stomach (*Wibmer*).—*Dose,* 10 to 30 gr.

Ammonium, Nitro-sulphate of. *Syn.* AMMO′′NII NITRO-SUL′PHAS, L. Dissolve 1 part sulphate of ammonium in 5 parts of solution of ammonia, and pass nitric oxide gas through the solution; rapidly wash the crystals that form with a solution of ammonia, dry in bibulous paper, without heat, and preserve them in a well-stoppered bottle. —*Dose,* 10 to 20 gr.; in typhoid fevers, &c.

Ammonium, Oxalate of. $(NH_4)_2C_2O_4H_2O$. *Syn.* AMMO′′NIÆ OX′ALIS, L.; OXALATE D'AMMONIAQUE, Fr. Neutralise a hot solution of oxalic acid with carbonate of ammonium, evaporate and crystallise.

Prop. It forms beautiful colourless long rhombic prisms, which effloresce in the air, is slightly soluble in cold water and freely soluble in hot. Heated in a retort it yields ammonia, carbonate of ammonium, cyanogen, and carbonic acid, together with oxamide, which sublimes.

Uses, &c. In *chemistry,* chiefly as a reagent for calcium salts (with which it produces a white precipitate soluble in nitric and hydrochloric acids), and to separate calcium from magnesium salts, since it does not throw down the latter from solution. A BINOX′ALATE may also be formed; but it possesses no practical interest.

Ammonium, Phosphate of. $(NH_4)_3PO_4$. *Syn.* AMMO′′NII PHOS′PHAS, L. *Prep.* Saturate a solution of phosphoric acid with carbonate of ammonium in slight excess, gently evaporate, and crystallise by refrigeration.

The mono- and bi-acid phosphates of ammonium are now manufactured in quantity for the Legrange process of sugar refining. For this purpose, superphosphates are extracted with hot water until a strong solution is obtained, ammonium sulphate added, and the calcium sulphate filtered off. To the solution of ammonium monophosphate and phosphoric acid so obtained, ammonia is added until neutral, when a further small quantity of calcium sulphate comes down. To the filtrate, which should now have a strength of 20° Baumé, ammonia is added in quantity sufficient to form the di-ammonium phosphate, and the liquid is left to crystallise.

Diuretic, discutient, and antilithic.—*Dose,* 3 to 10 gr., or 20 to 30 drops of a saturated solution, 3 or 4 times a day; in gout, rheumatism, and

calculus, accompanied with the lithic-acid diathesis; also in rickets and certain forms of dyspepsia.

Ammonium, Suc'cinate of. *Syn.* AMMO''NII SUC'CINAS, L. *Prep.* 1. Succinic acid, 1 part; water, 4 parts; dissolve, neutralise with solution of ammonia or of ammonium carbonate in slight excess, evaporate, and crystallise as directed under the 'benzoate' or 'phosphate.'—*Dose,* 2 to 10 gr.

Ammonium, Sul'phate of. $(NH_4)_2SO_4$. *Syn.* SULPHATE OF OX'IDE OF AMMONIA, AMMO''NII SUL'PHAS, L.; SULPHATE D'AMMONIAQUE, Fr.; SCHWEFELSAUES AMMONIUM, Ger.; Glauber's SECRET SALT†, G. SECRET SAL AMMONIAC†, SAL AMMONI'ACUM SECRE'TUM GLAUBE''RI†, &c. Crude sulphate of ammonium exists in considerable quantity in the soot from pit-coal, and it is obtained, as a secondary product, from the ammoniacal liquor of gas-works and other processes of coal distillation. These last are its chief sources. It is also found native, associated with sal ammoniac, in the neighbourhood of volcanoes, under the name of '*mascagnine*' or '*massagnine.*' A detailed description of its manufacture has been already given.

Prep. 1. (Medicinal.) Saturate dilute sulphuric acid with carbonate of ammonium in slight excess, filter, gently evaporate, and crystallise.

2. (Commercial.) See AMMONIA.

Prop. Crystals (long, flattened, six-sided prisms); soluble in 2 parts of cold, and 1 of boiling water; fuses with loss of one atom of water, at about 138° C. (280° F.); and is volatilised, with entire decomposition, at about 279° C. (535° F.). Even its solution, by long boiling, becomes acid from loss of ammonia.

Uses, &c. Pure sulphate of ammonium is diuretic, aperient, resolvent, and stimulant.—*Dose,* 10 to 30 gr. It is now seldom employed in medicine. The crude sulphate is principally used in the preparation of sal ammoniac and carbonate of ammonium, and in immense quantities as a manure. See MANURES, ARTIFICIAL.

Ammonium, Sulphide of (neutral). $(NH_4)_2S$. *Prep.* Saturate a strong solution of ammonia with pure sulphuretted hydrogen gas; then add a second portion of solution of ammonia, equal in volume and strength to that first used, and preserve it in a well-stoppered bottle.

Ammonium, Hydrosulphide or Sulphydrate of. NH_4HS. *Syn.* SULPHIDE OF AMMONIUM, HYDROSULPHIDE OF AMMONIUM, HYDROSULPHATE OF AMMONIA. *Prep.* By passing sulphuretted hydrogen gas, to saturation, through a mixture composed of a strong solution of ammonia, 1 part, and distilled water, 4 parts.

Prop. Prepared as above, it has a very fœtid odour. When pure it is wholly volatilised by heat, and does not precipitate a solution of sulphate of magnesium. Mineral acids decompose it, with the evolution of sulphuretted hydrogen. By keeping, it decomposes and acquires a yellow colour. This yellow colouration does not, however, render it unfit for use as a reagent, but it must be borne in mind that it will now deposit sulphur when mixed with acids. In this state it proves valuable as a reagent to detect hydrocyanic acid, and as a solvent to separate metallic sulphides thrown down by sulphuretted hydrogen.

Uses, &c. It is principally employed by chemists as a reagent to precipitate metals, to separate metallic sulphides, &c.; and by perfumers as a mordant in dyeing hair. In *medicine* it has been used by Cruickshank, Rollo, and others, to check the morbid appetite, and to increase the action of the stomach and general tone of the system in diabetes mellitus. It has also been used by Brauw, Gruithuisen, and others, in old pulmonary and vesical catarrhs. It is a powerful sedative, lessening the action of the circulatory system, causing nausea, vomiting, vertigo, drowsiness, &c.—*Dose,* 3 to 6 drops, three or four times daily, mixed with pure water, and instantly swallowed. In large doses it is poisonous.

Ant. Very dilute solution of chlorine, or of chlorinated lime or soda, followed by a powerful emetic or the stomach-pump. When the vapour has been respired, free exposure to fresh air, with the head a little elevated, and copious affusions of cold water, with moderate draughts of brandy-and-water, and the use of the smelling-bottle (ammoniacal) should be adopted. If need be, artificial respiration should be attempted, and the air around the patient should be slightly impregnated with the fumes of chlorine or chlorinated lime.

Ammonium, Persulphide of. *Syn.* BOYLE'S FUMING-LIQUOR, HOFFMAN'S VOL'ATILE SPIRIT OF SULPHUR, &c.; AMMO''NIÆ PERHYDROSUL'-PHAS, A. PERHYDROSULPHURE'TUM, &c. Authorities differ as to the constitution of this liquid, which, since its introduction by Beguin in 1650, has passed under more 'aliases' than perhaps any other preparation. Its precise position amongst the ammonia compounds is still undecided.

Prep. 1. (*Beguin.*) Sulphur, 1 lb.; quicklime, ½ lb.; sal-ammoniac, 4 oz.; mix and distil.

2. (*Boyle.*) Sulphur and sal-ammoniac, of each, 5 oz.; quicklime, 6 oz.; as last.

3. (*Liebig.*) Agitate the common hydrosulphide of ammonium with pure sulphur, until the latter ceases to be dissolved; and, after repose, decant the clear liquid.

Prop., &c. An orange yellow, fuming, fœtid liquid, of an oily consistence, having the characteristics of the common sulphydrate in a remarkable degree. It may prove an excellent medicine. "Useful for wounds and ulcers" (*Beguin*). Diluted with three parts of spirit of wine, it formed the LIQUOR ANTIPODAG'RICUS of F. Hoffman, of which we are told that about 30 drops acted as a strong sudorific; and applied externally, mixed with camphor, "it relieved pain like a charm" (*Hoffman*). The sulphides of ammonium are now scarcely ever employed as remedies.

Ammonium, Sul'phite of. $(NH_4)_2SO_3 . 7Aq$. *Syn.* AMMONII SULPHIS, L. Prepared by passing sulphurous acid gas into a solution of ammonia. It is crystallisable and very soluble in water.

Ammonium, Sulphocyanide of. NH_4CNS. *Prep.* 1. Neutralise sulphocyanic acid with ammonia, and gently evaporate the solution to dryness, by the heat of a water-bath.

2. Digest hydrocyanic acid with yellow sulphide of ammonium, and, after a time, evaporate as before.

A deliquescent, white, saline mass, very soluble

in water, but seldom employed out of the laboratory in a pure state. Of late it has been obtained in quantity as a crude product of the gas liquors. It is a very delicate test reagent for ferric salts, giving with mere traces, in acid solution, a deep red colour.

Ammonium, Tartrates of. Of these there are two:

Ammonium, Neutral Tartrate of. $(NH_4)_2C_4H_4O_6$. *Syn.* AMMO′′NIÆ TAR′TRAS, L. *Prep.* Saturate a solution of crystallised tartaric acid (150 gr.) with carbonate of ammonium (118 gr.), and either evaporate the solution at a gentle heat and crystallise, or evaporate to dryness and powder the residuum.

Prop., &c. Prismatic crystals, or a crystalline mass; soluble and efflorescent. Its medicinal properties and doses resemble those of citrate of ammonium.

Ammonium, Bitartrate of. $NH_4HC_4H_4O_6$. *Syn.* AMMO′′NIÆ BITAR′TRAS, L. *Prep.* To a strong solution of tartaric acid add another of carbonate of ammonium, or of tartrate of ammonium, as long as a precipitate falls, which must be collected and dried.

Prop., &c. A crystalline powder, only slightly soluble in water, closely resembling ordinary cream of tartar. It is diaphoretic, diuretic, and deobstruent, and is frequently, though improperly, sold for the preceding preparation.

Ammonium, Valerianate of. $NH_4C_5H_9O_2$. *Syn.* AMMO′′NIÆ VALERIA′NAS, L. *Prep.* Saturate valerianic acid with strong solution of ammonia, and evaporate the resulting liquid to a syrupy consistence at a temperature under 175° F.; then add twice its volume of alcohol and, after agitation, allow it to crystallise by spontaneous evaporation. —*Dose*, 2 to 8 or 10 gr.; in neuralgia, epilepsy, hypochondriasis, hysteria, low fevers of an intermittent kind, &c.; also in dyspepsia and debility complicated with these affections.

AMŒBA. A unicellular organism belonging to the Protozoa. It is found at the bottom of fresh-water pools and on leaves in damp situations. Its indefinite and constantly changing form has procured for it the name of the 'Proteus animalcule.' There are various forms, ranging in size from minute microscopic objects to others barely visible to the naked eye.

The animal consists of an irregular mass of protoplasm, which can be protruded at any point of the surface and again retracted. These processes are called '*pseudopodia*.'

The external layer of the protoplasm is called the '*ectosarc*.' It is clear, and denser than the inner portion, or '*endosarc*,' which is granular and more fluid. The 'endosarc' is in a state of more or less constant movement; it enters the protrusions of the 'ectosarc,' and is rendered obvious by the granules present in it.

Within the 'endosarc' there is a spherical or oval body, '*the nucleus*,' denser than the rest of the endosarc and highly refractile. It is not easily seen during life, but may be made more visible by killing the Amœba with a 1% solution of acetic acid in water. There may be more than one nucleus.

The *pulsating vacuole* is a space in the endosarc filled with watery fluid; it is fairly constant in position, and pulsates rhythmically.

The Amœba multiplies by 'fission,' *i.e.* the whole mass splits into two, each containing a part of the nucleus, endosarc, and ectosarc of the original animal.

If indigo, carmine, Indian ink, or other finely divided pigment be allowed to run under the coverslip, it will be seen that the animal takes up the particles over its *whole* surface.

AMŒBOID. Having the properties of an Amœba. Generally applied to movement.

AMONTILLADO. [Sp.] See SHERRY and WINE.

AMORPH′OUS. *Syn.* AMORPH′US, L.; AMORPHE, INFORME, DIFFORME, Fr.; AMORPHISCH, MISGEBILDET, MISGESTALTET, Ger. Shapeless. This term is applied in *chemistry* and *mineralogy* to solid bodies devoid of regular or crystalline form, *e.g.* to opal (a form of silica), glass, resin, coal, and many precipitates, &c. The corresponding substantive is AMORPHISM.

AMPELIDEÆ. The vine order, of which the grape-vine (*Vitis vinifera*, L.), the most important plant of the order, may be taken as the type. They are all climbing, jointed shrubs, often with abortive flower-branches serving as tendrils to lay hold of their support. They are chiefly East Indian. The grape-vine, now cultivated so extensively in France, Germany, Southern Europe, Atlantic islands, United States, the Cape, &c., was probably originally a native of Western Asia and to the south of the Caspian. See VINE.

AMPHIB′IA (fĭb′-y'ă). [L. pl.; prim. Gr.] *Syn.* AMPHIB′IANS (-yănz), AMPHIB′IALS (-y'ălz). Animals that possess the faculty of living both in water and on land. Professor Huxley, in his 'Anatomy of the Vertebrate Animals,' describes the Amphibia as follows:

"The only clearly diagnostic characters of this class as compared with fishes are the following: —1. Amphibia have no fin-rays. 2. When limbs are present they contain the same skeletal elements as those of the higher Vertebrata. Certain other structural peculiarities are common to the whole of the Amphibia without being diagnostic. Thus:

"1. The body is usually devoid of any exoskeleton, and when scales or scutes are present as in recent Amphibia they are concealed within the skin. In the extinct Labyrinthodonta, the dermal armour is confined to the ventral aspect of the body.

"2. The vertebral centra are always represented by bone.

"3. The sacrum rarely consists of more than one vertebra, though there are individual exceptions to this rule.

"4. The suspensorial apparatus of the mandible is continuous with the skull, which has two occipital condyles, and no completely ossified basioccipital.

"5. There are no sternal ribs.

"The primary subdivisions or orders of the Amphibia are the following:—Urodela (newts), Anura (frogs and toads), Cæciliæ (peromela), and the Labyrinthodonta (extinct forms found in the newer Palæozoic and older Mesozoic formations)."

The term is also often applied, colloquially, to otters, seals, walruses, crocodiles, &c., none of which can breathe under water, although, from

the languid nature of their circulation, they are able to remain a long time in it.

AMPHIB'IOUS (y'ŭs). *Syn.* AMPHIB'IUS, L.; AMPHIBIE, Fr.; BEIDLEBIG, Ger. In *botany* and *zoology*, having the faculty of growing or living both on land and in water. See AMPHIBIA.

AMPHICŒLOUS. Having cavities at both ends. A term used in anatomy of the vertebræ when the bodies are concave on both surfaces.

AMPHIOXUS LANCEOLATUS. The lancelet, a small, semi-transparent, fish-like animal, about a couple of inches in length, found in shallow parts of the Mediterranean and other seas. It is of sluggish habits, and usually remains buried in the sand, either completely or with the anterior end alone protruding; but if disturbed it swims actively by rapid lateral movements of the body. Morphologically Amphioxus is distinctly a vertebrate animal, but in many very important particulars it is simpler and altogether of a more primitive form than any of the better known members of the Vertebrata. So great are these differences that it is necessary to divide the vertebrates into two classes, the *Acrania*, which includes the Amphioxus and a degenerate group, the Ascidians; and the *Craniota*, which includes all the remaining vertebrates from fish to mammals. The skeleton is extremely simple. It contains neither bone nor cartilage; but remains throughout life in a condition which corresponds closely to a very early stage in the development of the vertebrates. The alimentary canal is a straight tube, the anterior part of which is adapted for respiration, as in most of the aquatic vertebrates. The animal can only be studied properly by means of sections prepared for examination under the microscope.

AMPHORA. A large vessel of earthenware, used by the Greeks and Romans for preserving wine, &c. It was usually furnished with a handle on either side of the neck, hence its name.

It was also used as a standard measure of capacity by the Greeks and Romans. The Attic amphora contained nearly nine gallons, and the Roman amphora about six.

AMYGDALIN. $C_{20}H_{27}NO_{11}3Aq$. This substance exists in bitter almonds. It crystallises in pearly white plates, which are odourless and almost tasteless. It is nearly insoluble in hot and cold water and in cold alcohol, but soluble in boiling alcohol. To prepare amygdalin, boil well-pressed cake of bitter almonds twice in strong alcohol; strain through linen, and press the residue; remove any oil that may appear, heat the liquid again, and filter. In a few days part of the amygdalin crystallises out. Concentrate the residuary liquor to a sixth part, and add ether, which will throw down the amygdalin. Press it between blotting paper, wash it with ether, and set aside to crystallise. Amygdalin, when added to emulsin in the presence of water, splits into essential oil of almond, hydrocyanic acid, and glucose.

AMYG'DALOID (-loyd). *Syn.* AMYGDALOID'AL; AMYGDALOÏ'DES (-dēz), L.; AMYGDALOÏDE, Fr. Almond-shaped. In *mineralogy*, amygdaloid is 'toadstone.'

AMYKOS (Galen, Upsala). A cosmetic and mouth-wash. Claims to be prepared according to an English patent. It is an aqueous extract of 420 grms. cloves, boiled in a gallon of water, in which 420 grms. of pure glycerine are dissolved, and to which 210 grms. of borax are added (*Hager*).

AMYKOSASEPTIN is linen saturated with a hot solution of borax (*Nyström*).

AMYL. PENTYL $(C_5H_{11})'$. The (unsaturated) radicle of the amyl compounds, and therefore only known in combination. Eight different isomeric forms of it are possible.

AMYL ACETATES. $C_5H_{11}C_2H_3O_2$. The liquid which is sold as *essence of jargonelle pear*, and which is now extensively manufactured, is an alcoholic solution of iso-amyl acetate, also known as *pear oil*. The latter is prepared, more or less pure, by distilling together 1 part fusel oil, 2 parts dry acetate of potassium, and 1 part concentrated sulphuric acid, the usual precautions being observed. The distillate is purified by washing with a very dilute solution of potash, and redistilling from fused chloride of calcium. If a little litharge be added, before rectification, to the liquid in the retort, it will remove any traces of sulphurous acid present. W. V. Wilson (Eng. Pat. 4669/85) prepares amyl acetate by mixing fusel oil with acetate of lime, adding hydrochloric acid in excess and distilling. Iso-amyl acetate is a limpid, colourless liquid, insoluble in water, but soluble in alcohol, and boiling at 138° C. (280° F.). An alcoholic solution of potash saponifies it, of course, to iso-amyl alcohol and potassic acetate. See SAPONIFICATION.

Uses. The above-mentioned *essence* is much used for flavouring liqueurs and confectionery. Amyl acetate further recommends itself as a standard illuminant, being an inexpensive commercial product which can be easily obtained pure, and giving a light very similar to that of gas and of incandescent electric lamps (see PHOTOMETRY). A solution of nitro-cellulose in amyl acetate (W. V. Wilson and J. Storey, Eng. Pat. 6051/84) is used as a varnish for a variety of purposes. When 200 parts of nitro-cellulose are mixed with 600 parts of amyl acetate, a mass of a doughy consistency is obtained, which can be employed for any of the purposes for which celluloid is used. It has lately been applied in photography, the varnish drying more quickly than collodion. Lastly, by adding to amyl acetate castor oil, china clay, and a small proportion of certain essential oils, a mixture suitable for the production of artificial leather may be obtained.

AMYL ALCOHOLS. $C_5H_{11}OH$. Of these seven are known, eight being theoretically possible. (See also AMYLENE HYDRATE.) Fusel oil (which *see*) is a mixture of optically active $\left(\begin{smallmatrix}CH_3\\C_2H_5\end{smallmatrix}\right>CH-CH_2OH)$, and inactive amyl alcohol $(CH_3)_2-CH-CH_2-CH_2OH)$; the latter, which forms the chief constituent, is also known under the names of FERMENTATION AMYL ALCOHOL and FUSEL OIL.

To obtain pure amyl alcohol from fusel oil (G. K. Field, Eng. Pat. 2517/82), distilled petroleum spirit—whose boiling temperature should not be much over 100° C.—is added to the latter. The amyl alcohol present dissolves completely, water and propyl and butyl alcohols being left undis-

solved. The upper layer, consisting of the solution of amyl alcohol in petroleum spirit, is then subjected to fractional distillation.

L. Haitinger ('Chemiker Zeitung,' vi, 961) finds that commercial amyl alcohol frequently contains bases (pyridine, &c.). This fact should be noted, since amyl alcohol is often employed in the estimation of the alkaloids, when the presence of such nitrogenous bases would vitiate the results obtained.

AMYL COLLOID. *Syn.* ANODYNE COLLOID. Take of hydride of amyl 1 oz., aconitine 1 gr., veratrine 6 gr., collodion to 2 oz. Used as a local anodyne to relieve the pain of neuralgia, sciatica, and lumbago.

AMYL HYDRIDE. PENTYL HYDRIDE, PENTYLENE. The lightest and most inflammable liquid of the petroleum series. Obtained by fractional distillation from petroleum spirit. Sp. gr. ·625 to ·649. Inhaled, it produces anæsthesia; locally applied, it freezes rapidly. An impure product is much used by dyers for removing grease and cleaning gloves.

AMYL NITRITE. $C_5H_{11}NO_2$. B. Pt. 99° C. (210° F.). *Syn.* AMYL NITRIS, B. P. This compound is prepared by passing nitrous fumes (obtained by acting upon arsenic trioxide or starch with nitric acid) into amyl alcohol; also by dissolving amyl alcohol in its own volume of sulphuric acid, heating the mixture, after it has become cold, with a solution of 26 parts of potassic nitrite in 15 parts of water, and then distilling ('Roscoe and Schorlemmer's Chemistry,' vol. iii, part 1). Mr Umney ('Pharm. Journal') says that true nitrite of amyl should be made by passing nitrous acid into amylic alcohol which has been previously submitted to a fractional distillation, until the portion retained for use has a boiling point of 132° C. A nitrite so prepared, when deprived of any excess of acid it may contain, by rectification over fused carbonate of potash, will have a boiling point of 98°—99° C. It is a light yellow liquid, of a disagreeable and stupefying odour, its vapour being explosive.

Williams and Smith ('Year-book of Pharmacy,' 1885) give the following instructions for its preparation:—"In a glass vessel, fitted with exit tube and stoppered acid funnel, place some pure nitrite of sodium and a little water, and allow nitric acid, of sp. gr. 1420, to flow slowly in. The gas evolved (NO_2) is passed into the upper part of a vessel containing arsenious acid and nitric acid, of sp. gr. 1500, and giving off a red gas (N_2O_3). The two gases are allowed to mix, care being taken to keep the gas evolved from the nitrite of sodium in excess, and then passed into amyl alcohol kept cool. The washed product when distilled gave 10% passing over below 90° C., 87% below 100° C., 93% below 105° C."

Prop. A yellowish liquid of peculiar fruity odour; sp. gr. ·887. Insoluble in water, soluble in alcohol. By exposure it readily changes, becoming weak. It should be kept in hermetically sealed glass capsules. It is employed to relieve angina pectoris, spasmodic asthma, sea-sickness, croup; also to ward off epileptic attacks, and as an antidote to chloroform. Half a minute after inhaling a dose, it causes flushing of the face. —*Dose,* by inhalation, 2 to 5 minims; if swallowed in a mixture, ½ to 1 minim.

AMYL VALERATE, $C_5H_{11}O(C_5H_9O)$. B. Pt. 188° C. (370° F.) *Syn.* APPLE OIL, APPLE ESSENCE, &c. This compound is abundantly formed as a bye-product in the preparation of valeric acid (which *see*) from potato oil (impure fermentation amyl alcohol), and is recognised by the offensive odour of rotten apples evolved during the process. By treating the crude product of the distillation with a weak solution of potash, the valeric acid is taken up, and the ether obtained nearly pure. Dissolved in rectified spirit, it forms the 'apple essence' now so much employed as a flavouring ingredient for confectionery and liqueurs. See FRUIT ESSENCES.

AMYLA'CEOUS (ăm-e-lā'-sh'ŭs). *Syn.* AMYLA'CEUS, L.; AMYLACÉ, Fr. Of or like starch; consisting of or abounding in starch; starchy. See FOOD, NUTRITION, STARCH, &c.

AMYLENE [Eng., Fr.], *pentene,* C_5H_{10}. A considerable number of isomeric amylenes (members of the olefine series of hydrocarbons) are known, 'commercial amylene' being a mixture of several of these. (Among them may be mentioned ISO-AMYLENE, which is obtained by heating ordinary amyl iodide with caustic potash, also by distilling iso-amyl alcohol with zinc chloride. It is a colourless, very volatile liquid, resembling ether, with a smell of apples.)

Prep. From fusel-oil repeatedly distilled along with either anhydrous phosphoric acid or a concentrated solution of chloride of zinc; the product being repeatedly rectified at a low temperature, until the boiling point sinks to 39° C. (102° F.).

Prop., Uses, &c. An ethereal liquid, lighter than water, having an aromatic odour, slightly alliaceous. Sp. gr. of vapour, 2·68. Its vapour was several times successfully employed by the late Dr Snow as a substitute for ether and chloroform in producing anæsthesia, being, though less agreeable, also less pungent, and consequently easier to breathe, than either of these; but its use has since been given up owing to doubts as to its safety, two or three deaths having followed its inhalation.

AMYLENE HYDRATE. $\left.\begin{matrix}(CH_3)_2\\C_2H_5\end{matrix}\right\rangle COH$. AMYLENI HYDRAS, DIMETHYL-ETHYL-CARBINOL.

This compound is one of the amyl alcohols, which *see.*

It is made by treating trimethyl-ethylene with sulphuric acid, amyl-sulphuric acid being formed as an intermediate product, and breaking up on distillation with water, with the production of the tertiary alcohol. It is a clear, oily liquid, of pungent odour. Dissolves freely in alcohol and in 19 parts water. It boils at 102·5° C. Sp. gr. at 12° C. ·812.

Uses. A soporific, given to patients suffering from heart affections. It produces no systemic disturbance.—*Dose,* 30 to 80 minims, flavoured with liquid extract of liquorice.

ANACARDIUM OCCIDENTALE. Cashew tree. Known in Jamaica as the cashew apple. Order ANACARDIACEÆ. The fruit called ashew nut is about 1 in. long, ½ an in. thick, and ¾ of an in. broad, having a smooth, shining, and grey exterior; it contains a white, oily, almond-like, sweet seed.

The pericarp is filled with a sticky oleo-resinous substance which exudes in almost colourless drops, turning black in contact with the air. This substance is a powerful caustic, producing vesication on contact with the skin, and bringing out an eczematous rash. In Porto Rico the juice is used extensively as a vesicant and pustulant. The juice contains *anacardic acid* and *cardol*; the latter is the vesicating principle. The bark of the tree, in the form of decoction, is used as an astringent tonic. A tincture of the cashew nut (1 in 10) is given internally as a vermifuge. —*Dose*, 2 to 10 minims.

ANACHRONISM. A neglect or falsification, whether wilfully or otherwise, of strict chronological relation. Anachronisms may be committed in a great variety of ways, *e. g.* in painting, by representing members of the Holy Family in the costumes of the period at which the painter lived, as in many of the pictures of the old masters; on the stage, as in the last century when Alexander the Great appeared on the French stage in the costume of the time of Louis XIV. Anachronisms are sometimes deliberately introduced into historical novels and other similar works with a definite object, and this should always be taken into account in judging of an author's accuracy.

ANACONDA. A gigantic snake of South America known as the water-serpent, and said to sometimes attain a length of 30 ft. or more. It frequents swamps and rivers, and its food consists of small water animals. Its colour is a rich brown with bright golden rings on each side, and two rows of large black spots along the back. The Anaconda has, for some reason or other, been regarded as a most dangerous reptile, even more so than the boa constrictor, whereas the reverse would appear to be the case; neither is it venomous. The natives kill it for the sake of an oil which they obtain from its body.

ANADOLI (Kreller, Nuremberg). An oriental tooth-powder. Powdered soap, 42 parts; starch powder, 44 parts; levantine soapwort, 12 parts; oil of bergamot and lemon to flavour (*Wittstein*).

ANÆMIA. Deficiency of blood in quantity, either general or local; also, deficiency of the most important constituents of the blood, especially albuminous substances and red corpuscles.

ANÆSTHE'SIA (ăn-ēz-the'-zh'ă; -sh'ă; -thēze'-y'ăr). [L.; prim. Gr.] *Syn.* ANESTHÉSIE, Fr. In *pathology*, diminished or lost sense of feeling, which may be general or local. More especially used to indicate loss of tactile sensibility as distinguished from ANALGESIA, or insensibility to pain.

In *surgery* and *obstetrics*, the production of temporary anæsthesia, for the purpose of rendering operations painless, relieving the pangs of childbirth, &c., is effected by the use of—

ANÆSTHET'ICS. *Syn.* ANÆSTHET'ICA, L.; ANESTHÉTIQUES, Fr. In *pharmacology* and *surgery*, substances or agents which diminish or destroy sensibility, or which relieve pain. In its full extent this term includes both anodynes and narcotics; but it is now more generally confined to those substances which greatly diminish common sensibility, or entirely remove susceptibility to pain. Among the most useful, safe, and powerful of this class are chloroform, ether, nitrous oxide, cocaine, and intense cold; besides several chlorinated compounds, such as the bichlorides of ethylene, methylene, and carbon.

More than 1500 years ago the Chinese are said to have used a preparation of hemp, or *ma-yo*, to annul the pain attendant upon cauterisation and other surgical operations. Mandragora (mandrake) was employed for a similar purpose by the Greeks and Romans; and we learn that as early as the thirteenth century the vapour from a sponge filled with tinctures of mandragora, opium, and other sedatives was used for a similar purpose.

Baptista Porta, in his work on natural magic printed in 1597, mentions a quintessence extracted from medicines by somniferous menstrua, of the nature of which he leaves us in ignorance. This quintessence was to be preserved in leaden vessels very perfectly closed, lest the aura should escape, for the medicine would vanish away. Furthermore, he adds, "when it is used, the cover being removed, it is applied to the nostrils of the sleeper, who draws in the most subtle power of the vapour by smelling, and so blocks up the fortress of the senses, that he is plunged into the most profound sleep, and cannot be roused without the greatest effort." Dr Iron suggested that the volatile substance was sulphuric ether, which he says had been described more than fifty years before Porta wrote his book. In the year 1800 Sir Humphry Davy suggested the employment of nitrous oxide, or laughing gas, as it was then termed, for minor operations in surgery, and in 1828 Dr Hickman proposed carbonic acid as an anæsthetic. The vapour of sulphuric ether had been used in his practice by Dr Pearson as early as 1795, for the relief of spasmodic asthma. The fact that sulphuric ether was capable of producing insensibility was demonstrated by American physicians, viz. by Godwin in 1822, Mitchell in 1832, Jackson in 1833, and Wood and Bache in 1834; but the first practitioner to employ it to prevent the pain of an operation was Dr Morton, a Boston dentist, who successfully used it for this purpose in 1846. On the 19th of December of the same year Mr Liston, of University College Hospital, London, and Mr Robinson, a dentist, operated upon patients who had been rendered insensible by means of the inhalation of the vapour of ether.

Throughout the year 1847 ether was employed as an anæsthetic both in England and France, but towards the end of that year the anæsthetic properties of chloroform were pointed out by Flourens. The first, however, to introduce this agent into surgical and obstetric practice was Dr I. T. Simpson, of Edinburgh. In 1849 a work on the inhalation of ether was published by Dr Snow, who afterwards introduced a new anæsthetic, viz. amylene, which was capable of producing effects similar to those of chloroform; but as two patients out of but a small number who inhaled the vapour of amylene died, this latter soon fell into discredit, and consequent disuse.

Many other compounds have been experimented with and suggested as substitutes in certain cases for the others above named, but these latter

require special management in their administration, and it is doubtful whether their supposed advantages are not more than counterbalanced by these difficulties; at any rate they appear to have operated against their general use.

There are a number of other agents which might be included in a list of anæsthetics, for all that is required to produce anæsthesia is to reduce the supply of blood to the nervous centres, or to introduce into the blood some substance capable of diminishing its power of oxygenating the tissues. Many of these agents are, however, to be rather classed as poisons than as useful to the surgeon in diminishing the pain of operation.

There are three ways in which anæsthesia may be induced: (1) By benumbing the part to be operated upon by means of cold; (2) by cutting off its nerve supply; (3) by arresting the activity of the nervous centres concerned in sensation. We are thus enabled to divide anæsthetics into two groups *local* and *general* anæsthetics.

Local anæsthesia is generally induced by the application of cold to the part; this may be done by the use of ice or a mixture of ice and salt placed in a muslin bag; but this is not easy of application, and is hardly ever used when it is possible to make use of ether spray, as suggested by Dr B. W. Richardson. All that is necessary is to direct a very fine spray of pure anhydrous ether upon the part, previously carefully dried, from a suitable spray apparatus; the anæsthesia produced is fairly complete, and is very convenient in some minor operations.

The local application of chloroform causes some numbness, but it is of little real value except inside the mouth, and there its efficacy in all probability depends upon the vapour inhaled by the patient.

General anæsthesia is almost invariably induced by inhalation, although the subcutaneous injection of chloral and morphia has been tried with success, and is in some cases exceedingly useful.

The question frequently arises, is a given patient a fit subject for the administration of anæsthetics? This will be further discussed under the individual agents. It will suffice here to say that, generally speaking, a person fit to undergo a serious operation is able to take an anæsthetic, but in all cases the greatest care is requisite to avoid accidents and to guard against possible dangers.

The strong and vigorous, who inhale deeply and struggle a great deal, require more care in the administration of anæsthetics than the young and delicate, for whom a very small dose usually suffices. Ether is thought to be more suitable in cases of fatty degeneration of the heart, but such subjects usually do very well under chloroform. Drunkards are patients requiring great care, and a great proportion of the deaths, which have occurred under chloroform, have been cases of alcoholism more or less pronounced. It would appear to be a matter of general experience that the presence of alcohol in the system intensifies the effects of an anaesthetic.

The manufacture, chemical properties, and tests for chloroform will be found under *chloroform*. This is the most convenient of all anæsthetics, and the most easy to administer, but, unfortunately, when given beyond a certain strength it appears to be liable to produce cardiac syncope, and it is probable that some persons are specially affected by it in this way, hence its administration requires care and attention. Chloroform should always be given gradually, and the proportion of chloroform vapour should be carefully regulated rather than the supply of fresh air. Six to eight minutes at least should be allowed for the process. Sponges, lint, and the like, saturated with chloroform and held close to the mouth, are inconvenient and sources of danger, as the supply cannot be controlled. The simplest plan is to use the corner of a clean towel or handkerchief, so folded as to form a cup, which may be held at a little distance from the mouth and nose, the anæsthetic being dropped a little at a time upon the upper surface. There are two forms of apparatus intended to serve this purpose, known as Skinner's and Esmarch's; they consist of convex wire frames, over which a piece of thin cloth is stretched. Skinner's is perhaps the better of the two, as, though it has to be held in the hand, it ensures a free admission of air, which Esmarch's, being fastened to the head, does not.

The advantages of chloroform over ether seem to be:

1. Less quantity is required.
2. The action is more rapid and complete, and generally more persistent.
3. Patients prefer it to ether.
4. It is less expensive.
5. Its odour is more agreeable.
6. No special apparatus is required.

The mode of administration above described gives the administrator great control, and with chloroform this is particularly necessary in order to avoid accidents. The fresh chloroform can be supplied drop by drop as required, and if necessary the administration stopped instantly. The movement of swallowing is an excellent guide to the proper strength of the vapour. Laryngeal obstruction, which sometimes occurs, arises chiefly from two causes, spasm of the glottis, which is excited sometimes by the vapour, and also as the result of reflex action during certain operations in which nerves are injured; and a falling down of the epiglottis, which arises from a sluggishness of the local muscles consequent upon the action of the anæsthetic. In these cases the head should be kept back and the chin raised, and if necessary the tongue pulled forward. The pulse should be most carefully watched throughout the whole period of administration, and if it show any signs of irregularity or flagging the tongue should be pulled forward, and the entrance of fresh air facilitated. Apparatus has been contrived for regulating the proportion of chloroform vapour to air, but, being somewhat complicated, it has not come into general use, the simple method above described proving in skilled hands perfectly satisfactory.

The committee of the Royal Medical and Chirurgical Society (Report 'Trans. Roy. Med. Chir. Soc.,' vol. xxiii, 1864) report, among other things:

"1. Chloroform should never be given carelessly, and the attention of the administrator should be entirely devoted to his duty.

"2. No person should administer chloroform to himself, under *any* circumstances.

"3. Anæsthetics should not be given after a long fast or soon after a meal. Three or four hours after food is the best time.

"4. There is no objection to the patient taking a small quantity of brandy, wine, or ammonia, before the administration.

"5. The recumbent position is preferable, sudden elevation or turning of the body should be avoided.

"6. Chloroform should invariably be given slowly, sudden increase of the anæsthetic is most dangerous; $3\frac{1}{2}\%$ is the average amount, and $4\frac{1}{2}\%$, with $95\frac{1}{2}\%$ of atmospheric air, is the maximum which can be required.

"7. The administrator should watch the administration and keep one hand free for careful observation of the pulse: the temporal artery answers all purposes, and is more convenient than the radial for the chloroformist.

"8. If a patient appears likely to vomit at the beginning of the administration he should at once be brought fully under the influence of the anæsthetic, and the tendency to vomiting will probably cease.

"9. The occurrence of sudden pallor, sudden lividity of the face, sudden failure or flickering of the pulse, and feeble or shallow respiration indicates danger, and the anæsthetic should be withdrawn until these symptoms have disappeared."

The directions given above will suffice in ordinary cases, but if the symptoms become more grave it may be necessary to dash cold water on the face and chest, and aid respiration by rhythmical compression of the thorax, or in more threatening cases to resort to artificial respiration.

The committee concluded that "chloroform at first increases the force of the heart's action; this effect is slight and transient." "The strongest doses of chloroform vapour when admitted freely into the lungs will destroy animal life by arresting the action of the heart." "And when complete anæsthesia is produced by chloroform the heart in all cases acts with less than its natural force." "By moderate doses of chloroform the heart's action is much weakened for some time; before death ensues, respiration generally, but not invariably, ceases before the action of the heart, and death is due both to the failure of the heart's action and to that of the respiratory functions." "The danger attending the use of chloroform increases with the degree of stupor it induces." "The committee recommend as preferable to either chloroform or ether the following mixtures.

"A. Alcohol, sp. gr. 838, 1 part; chloroform, sp. gr. 1·497, 2 parts. Ether, sp. gr. ·735, 3 parts.

"B. Chloroform, 7 parts; ether, 4 parts.

"C. Chloroform, 1 part; ether, 2 parts."

The committee concluded that "a mixture of ether and chloroform such as A. or C., is as effective as pure chloroform, and a safer agent when deep and prolonged anæsthesia is to be induced, while, at the same time, it is sufficiently rapid in its operation to be convenient for general use." It is a curious fact that, in spite of this recommendation, surgeons seem to prefer to use either chloroform or ether in an undiluted state.

Ether was first introduced as an anæsthetic in 1846. It is apparently less dangerous to life than chloroform, as under ordinary circumstances it does not depress the heart. It may be given either on a towel or hollow sponge, or by means of a specially constructed inhaler, of which numerous forms have been devised by Clover, Ormsby, Morgan, and others. A cone of leather or pasteboard lined with felt, and having an opening at the apex, is better than a sponge.

Many writers believe that ether in those rare cases in which its administration proves fatal, acts by causing asphyxia, but Mr Clover is of opinion that in some cases when anæsthesia is far advanced, it acts directly upon the heart. There is a general opinion that ether should not be administered in cases of kidney disease or bronchial trouble, and as consciousness returns quickly, it should not be used in protracted operations about the mouth, jaws, or pharynx; it should not be used in the neighbourhood of lighted candles, lamps, or the actual cautery, as the vapour is highly explosive. It is not desirable in cases of extensive atheroma of the arteries; infants and very young children are liable to great pulmonary trouble from its irritating influence on the respiratory mucous membranes. In midwifery the A. C. E. mixture (q. v.) is extensively used.

The following have been used as anæsthetics, but are chiefly interesting scientifically, as for various reasons they have not come into general use.

Diethyl has been used to produce local anæsthesia by means of the spray apparatus.

Olefiant Gas has been used, but it produced dilatation of the pupils, vomiting, and death, in some cases.

Amylene produces results similar to chloroform; Snow gave it in over 100 cases, but, two deaths occurring, its use was abandoned.

Ethyl Nitrate is pleasant and easy to inhale and a powerful anæsthetic, but it produces an acute sensation of noises in the head, giddiness, and headache, which lasts for some time.

Aldehyde was suggested by Professor Poggiale, of Paris, as superior to ether and chloroform, but it produces great bronchial irritation and a condition resembling a severe fit of spasmodic asthma.

Bisulphide of Carbon has been suggested as a local anæsthetic, but it is difficult to manage, its smell is very offensive, and it produces great headache and giddiness.

Ethylene Dichloride has been used, and is said to be much less dangerous than chloroform, but opinions on the subject differ, and it has never come into general use.

Ethyl Bromide was examined by Mr Nunneley, of Leeds, and employed by him on several occasions with success; Dr Chisholm, of Baltimore, used it 3000 times without a death, but its action seems to be evanescent and not suitable where profound anæsthesia is required.

Cocaine. This drug, an alkaloid derived from *Erythroxylon coca* (q. v.), was shown by Dr Hughes Bennett in 1874 to be an anæsthetic, and the solution of the drug is now largely used for producing local anæsthesia, so much so that the taking of cocaine by the laity to allay pain has

almost become a vice, the gravity of which does not appear to be realised, and which should be discouraged in every possible way. According to Dr Lauder Brunton its action is due to stimulation of the peripheral ends of the sympathetic, it affects first the cerebral hemisphere, next the medulla, and then the spinal cord; small doses quicken the pulse and large doses slow it; the drug is eliminated by the kidneys and seems to be accompanied in some cases by the production of albumen and sugar in the urine. For doses, &c., see COCAINE.

The first use of NITROUS OXIDE, as an anæsthetic, was apparently by Mr (afterwards Sir) Humphry Davy at Bristol, in 1799, to relieve the pain caused by a wisdom-tooth cutting the gum, and in 1800 he suggested its use in surgical operations, "in which no great effusion of blood takes place." For some time the gas was treated as interesting and amusing, on account of the ridiculous effects produced by its inhalation when mixed with air, but it is due to Dr Cotton, an American dentist (in 1867), that it has come into general use as an anæsthetic, especially in dental operations. The Odontological Society of Great Britain, as the result of Dr Evans's demonstration with Cotton's apparatus, considered the subject and issued a report upon it ('Trans.,' 1868). In the administration of nitrous oxide it is desirable at first to exclude air, and to fill the air-passages and lungs with the pure gas, the patient should breathe slowly and deeply, "the inspiration should not be jerky, and expiration should be complete." It is a special merit of laughing gas (as nitrous oxide is popularly called) that no harm can come of inhaling too freely at first. "It is imperative that the face-piece or mouth-piece should fit accurately, and the air-pad is almost essential to effect this in a great many cases. After five or six good respirations there is no need of supplying fresh gas with each inspiration; the expiring valve should be kept closed and the inspiring valve open; care must always be taken that the supply of gas is sufficient to replace any that is lost by absorption into the blood or by leakage. The condition of the patient under nitrous oxide cannot well be determined either by the lividity of the skin, the state of the pupils, or insensitiveness of the eyelids; the breathing should become stertorous or interrupted, or the pulse very feeble, or convulsive twitchings should occur, before the face-piece is removed. A little air may be admitted by raising the face-piece, if the operation is not upon the face, and by doing so every fourth or fifth respiration anæsthesia may be kept up for several minutes."

"The continuance of the gas without air brings on convulsive movements, so that it is not well adapted for operations lasting as much as five minutes and requiring steadiness. Sickness and headache ought not to result from the inhalation of the gas, but if its use is prolonged or the patient is kept in a semi-conscious state for several minutes, breathing a little air with the gas, both these symptoms may occur. The recumbent posture, quiet, and warmth to the feet, is all that is likely to be required by way of treatment" (*Clover*).

Nitrous oxide is obtained from nitrate of ammonium, and the particulars of its preparation may be found by referring to the article NITROUS OXIDE.

Immense quantities of the gas are used in dental operations. It has been computed that in 1870 Messrs Coxeter and Barth could not have prepared much less than 60,000 gallons in London alone. To fit it for transit it is reduced by compression. Fifteen gallons may thus be diminished in volume until it fills an iron bottle holding a quart. Five or six gallons of the gas are, on an average, required for each patient. In the preparation of nitrous oxide for surgical purposes Dr Evans advises it to be made at least 24 hours before it is used, and further recommends its being thoroughly washed. An apparatus for the preparation of the gas was devised by Mr Porter, a description of which will be found in the 'Transactions of the Odontological Society of Great Britain' for 1868, in which also mention is made of a face-piece for its administration, the invention of Mr Clover. By means of this latter instrument the desiderata that the nitrous oxide should be inhaled without admixture with atmospheric air, and contamination arising from the expired air given off by the patient, are accomplished, for it has been found that when excitement and talking attend the inhalation of the gas, these effects are due to the presence of the carbonic acid thrown off by the lungs.

When inhaled in the ordinary way, nitrous oxide gas induces exhilaration and narcotism, without asphyxia. When, however, the atmospheric air is carefully excluded, it produces, as we have just seen, anæsthesia without exhilaration. The time required to produce anæsthesia varies from 25 to 120 seconds, by from 10 to 60 inhalations. A patient has been subjected for 10 minutes to its action without experiencing any unpleasant symptoms or after effects. Mr Randle says it is perfectly safe in all short operations, and possibly in long ones also, provided there is due admission of air at proper intervals. It seems tolerably certain that nitrous oxide is largely absorbed by the blood-corpuscles, and it is probable that its presence in them may temporarily act to the exclusion of oxygen, and thus prevent for a time that combination of oxygen with hæmoglobin upon which the red colour of the corpuscles depends. Chemistry, however, has failed to show that nitrous oxide is decomposed in the blood, or that it exerts any of the chemical properties of oxygen on the constituent elements of the blood.

The whole available force in the body is due to oxidation. This oxidation is accomplished by means of the blood, and it is therefore evident that a continuous flow of oxygenated blood to the nerve centres is necessary as a source of power and of sensibility, as well as for the reintegration of nerve tissue. Any deficiency of oxygen in the blood is followed by a decreased arterialisation of the whole volume of the blood. Under these conditions the exhalation of carbonic acid is relatively less rapid than its formation, and life cannot continue if the blood in the arteries becomes thoroughly venous, as well in colour as in character. That nitrous oxide, when inhaled, changes the colour of the blood-corpuscles is evidenced by the livid appearance of the face and mucous surfaces; the latter, indeed, is a char-

acteristic accompaniment of its administration, and the darkened colour of the blood may be observed as it flows from the severed vessels. This colour of the blood is probably in part due to uneliminated carbonic acid; but that nitrous oxide possesses in a high degree the property of darkening the blood-corpuscles may be easily demonstrated by directing a jet of the gas for a few seconds upon a little arterial blood in a test-tube. Yet from what has previously been advanced on this point, this latter result may more strictly be due to physical than to chemical causes. An interruption of the circulation in any part of the organism is soon followed by local insensibility in the tissues from which the blood supply may have been withdrawn; and it is beyond dispute that, during the anæsthetic state, the circulation of the blood through the capillary system becomes diminished in velocity. A tendency to stasis begins to appear, accompanied at the same time by a considerable reduction in the supply of arterial blood.

The anæsthesia produced by the inhalation of nitrous oxide would, therefore, appear to be referable to an altered condition of the blood, whereby its usual properties and functions are interfered with, this interruption being probably due either to the retention of carbonic acid or to the presence of nitrous oxide; or, as the result of both conditions, to the exclusion of oxygen.

For minor operations nitrous oxide possesses many advantages over other anæsthetics. The principal of these is its safety. In America, in 200,000 cases in which it had been administered, there was only one case of death. Furthermore its use is not contraindicated in patients having any constitutional derangement, nor for women who are either pregnant or suckling.

Nitrogen, coal gas, and carbonic acid have also been employed as anæsthetics.

The 'British Medical Journal' for June 13th, 1868, contains an account of some experiments performed by Dr Burdon Sanderson, at Middlesex Hospital, with nitrogen. It seems to have been longer in producing insensibility than nitrous oxide, but no lividity of countenance accompanied, nor sickness or headache followed, its administration.

ANAGRAM. The transposition of the letters of a word or sentence. Inasmuch as the number of positions possible with even a small number of letters is very great (the total number can be found by multiplying the numbers together thus, $1 \times 2 \times 3 \times 4 \times \ldots . 10 = 3{,}628{,}800$), the term anagram is practically restricted to such transpositions of letters as result in the formation of other words having some meaning. Among the best known anagrams are:—'Honor est a Nilo,' from 'Horatio Nelson.' 'Flit on cheering angel,' from 'Florence Nightingale.' Voltaire's name is now generally believed to be an anagram on Arouet l. j., *i. e.* Arouet the Younger, his true name being 'François Marie Arouet.'

ANALEP'TIC. *Syn.* ANALEP'TICUS, L.; ANALEPTIQUE, Fr. Restorative; that recruits the strength lost by sickness.

Analep'tics. *Syn.* ANALEP'TICA, L.; ANALEPTIQUES, Fr. In *pharmacology*, &c., restorative medicines and agents.

ANAL'YSIS. [Eng., L.,] *Syn.* ANALYSE, Fr.; AUSLÖSUNG, ZERLEGUNG, Ger. In a general sense, the resolution of anything, whether an object of the senses or of the intellect, into its elementary parts. In *chemistry*, the resolution or separation of a compound body into its constituent parts or elements, for the purpose of either determining their nature, or, when this is known, their relative proportions. It is divided into QUAL'ITATIVE ANALYSIS and QUAN'TITATIVE ANALYSIS; and these again into PROX'IMATE ANALYSIS and UL'TIMATE ANALYSIS. The first consists in finding the components of a compound, merely as respects their nature or names; the second, in finding not merely the component parts, but also the proportions of each of them; the third gives the results in the names of the proximate or immediate compounds which, by their union, form the body under examination; whilst the fourth develops the chemical elements of which it is composed. Thus, suet consists of olein, palmitin, and stearin; these would form the 'terms' of the PROXIMATE ANALYSIS of this substance. But olein, palmitin, and stearin consist of carbon, hydrogen, and oxygen. The ULTIMATE ANALYSIS of suet would, therefore, have reference to the elements carbon, hydrogen, and oxygen.

An analysis may either be undertaken with the object of ascertaining all the constituents present in any mixture or compound, or merely of finding out whether a specific substance is or is not contained in any mixture, *e.g.* lead in wine; the extent of the investigation depends, of course, upon the object in view.

For success in chemical analysis a thorough acquaintance with the various properties of the elements and their compounds is required, as well as aptitude in applying this knowledge in discriminating between them, and in separating them from each other. Judgment and expertness in manipulation are, indeed, essential qualifications. The method pursued must likewise be such as will attain the object in view with certainty, and in the most expeditious manner. "The mere knowledge of the reagents, and of the reactions of other bodies with them, will not suffice for the attainment of this end. It requires the additional knowledge of a systematic and progressive course of analysis, or, in other words, the knowledge of the order and succession in which solvents, together with general and special reagents, ought to be applied, in order to effect both the speedy and safe detection of every individual component of a compound or mixture, and to prove with certainty the absence of all other substances. If we do not possess this systematic knowledge, or if, in the hope of attaining to an object more rapidly, we adhere to no method in our investigations and experiments, analysing becomes (at least in the hands of a novice) mere guess-work, and the results obtained are no longer the fruits of scientific calculation, but mere matters of accident, which sometimes may prove lucky hits, and at others total failures" (*Fresenius*).

A very full general account of 'analysis' is given by Professor Dittmar in 'Watt's Diction-

ary,' 2nd ed. Fresenius's 'Qualitative Analysis' and 'Quantitative Analysis' are standard works on the subject. 'Gas Analysis' has now also been very fully worked out. See QUALITATIVE ANALYSIS; QUANTITATIVE ANALYSIS; GASES, ANALYSIS OF; VOLUMETRIC ANALYSIS; ORGANIC ANALYSIS; SPECTROSCOPE, &c.

ANAMIRTA PANICULATA. See COCCULUS INDICUS.

ANANAS HEMP (*Ananassa sativa, S. Brumelia ananas,* as well as other species). This hemp comes from the West Indies and Central and South America, where the common ananas is cultivated. It is rather inferior to some varieties for spinning.

ANASTATIC PROCESS. In lithography, a method of converting a print or sheet of printed matter into a lithographic transfer by wetting with dilute nitric acid and the forcing it into contact with a plate of zinc in the press, the parts covered by the ink protect the zinc from the action of the acid, and an etching is produced which may be inked up and printed from in the usual way. The process is no longer in use, as much better results can be obtained by photolithography without the almost inevitable destruction of the original, which occurs in the anastatic process.

ANASTATICA HIEROCHUNTICA. See ROSE OF JERICHO.

ANATHERIN BALSAM. The following formula is published by the Netherlands Society:—Tincture of myrrh, 160 grms.; tincture of catechu, 80 grms.; tincture of guaiacum, 40 grms.; tincture of rhatany, 40 grms.; tincture of cloves, 30 grms.; spirit of cochlearia, 20 grms.; oil of cassia, 20 drops; otto of roses, 1 drop; proof spirit, 630 grms.

ANATHERIN BALSAM. (J. G. Popp, Vienna). A mouth-wash. Red sandal wood, 20 parts; guaiacum wood, 10 parts; myrrh, 25 parts; cloves, 15 parts; cinnamon, 5 parts; oils of cloves and cinnamon, of each, $\frac{2}{3}$ parts; spirit, 90%, 1450 parts; rose water, 725 parts. Digest and filter.

Dr Hager, who gives the above, says that on the expiration of the patent the following formula was published, but that a preparation made from that process had only a distant resemblance to the actual compound. Myrrh, 1 part; guaiacum wood, 4 parts; saltpetre, 1 part; to be macerated for a night with corn brandy, 120 parts; spirit of cochlearia, 180 parts. Then distil of this 240 parts, in which are to be digested for 14 days garden rue, cochlearia, rose leaves, black mustard, horseradish, pellitory root, cinchona bark, club-moss, sage-vetiver, and alkanet root, of each 1 part. Strain and filter, and to each 120 parts of the filtrate add 1 part of spirit of nitrous ether (*Hager*).

ANATOM'ICAL. *Syn.* ANATOM'ICUS, L.; ANATOMIQUE, Fr.; ANATOMISCH, Ger. Belonging to anatomy or dissection.

Anatomical Prepara'tions. Objects of interest in both surgical and pathological anatomy, and specimens in natural history, preserved by subjecting them to antiseptic processes, to which is also frequently added injection with coloured fluids (which subsequently harden); amalgams, or fusible metal, in order to display more fully the minute vessels, or the microscopic anatomy of the several parts. See ALLOY, FUSIBLE, INJECTIONS, PREPARATIONS, PUTREFACTION, SKELETONS, SOLUTIONS, MICROSCOPE, HISTOLOGY, TAXIDERMY.

ANCHO'VY (-chō'-). *Syn.* ANCHOIS, Fr.; ANCHOVE, ANSCHOVE, Ger.; ACCIUGHE, ANCHIOVE, It.; ANCHOVA, Port., Sp. The *Clu'pea encrasic'olus,* Linn., a small fish of the herring tribe, closely resembling the English sprat. It is common in the Mediterranean, and occurs in the greatest abundance and of the finest quality about the island of Gorgona, near Leghorn. It is taken in the night, during May, June, and July.

Anchovies are prepared for sale or exportation by salting or pickling them—the heads, intestines and pectoral fins having been first removed, but not the scales, and afterwards packing them, along with rock-salt, in the small kegs in which they are imported into this country. The small fish are more valued than the larger ones. For the table they are often fried to a pale amber colour, in oil or butter; having previously been scraped clean, soaked for an hour or two in water, wiped dry, opened (without dividing the fish), and had the back-bones removed. Before being put into the pan they are usually highly seasoned with cayenne; and after being again closed, are dipped into a rich light batter. They are also divided into fillets, and served as sandwiches, or in curried toasts. Anchovies are also extensively potted (POTTED ANCHOVIES), and made into butter (A.-BUTTER), and into sauce (A.-SAUCE), particularly the last.

The anchovy has a fine and peculiar flavour, and is eaten as a delicacy all over Europe. It was known to the Greeks and Romans, who prepared from it a kind of garum for the table. It is said to be aperitive, stimulant, and stomachic.

The high price of genuine Gorgona anchovies has led the fraudulent dealer to either substitute for them, or mix with them, fish of a less expensive kind. The most frequent SUBSTITUTIONS are Dutch, French, and Sicilian fish of allied species or varieties, sardines and even the common sprat. The genuine Gorgona fish is about the length of one's finger, and may be known by its silvery appearance; by the greater thickness of its head, which is sharp-pointed, with the upper jaw considerably the longer, and the mouth deeply divided; the dusky brown colour of its back, and the pink salmon colour of its flesh. The colour of the top of the head and back is, in the recent fish, blue, with a tinge of green (*Yarrell*). When only 3 months old, its flesh is pale; when of 6 months, rather pink; when of 10 to 12 months (or in its prime), a beautiful deep pink colour; and when much older, darker, but less lively. The fin-rays, varying in number with the age of the fish, are—

	Yarrell.	Hassall.
Dorsal	14	16 (?)
Pectoral	15	—
Ventral	7	—
Anal	18	19 (?)
Caudal	19	26 (?)

These fins are delicate in structure and greenish-white; and the membranes connecting the rays almost transparent. "The length of the head, compared with the length of the body alone, is as

1 to 3; the depth of the body but 2-3rds of the length of the head, and compared to the length of the whole fish is as 1 to 7; the tail is deeply forked, the gill-covers are elongated, and the scales of the body large and deciduous." "The breadth of the eye is 1-5th of the length of the whole head" (*Yarrell's* 'British Fishes'). Dutch fish may be generally known by being deprived of the scales, and the French fish by their larger size, and both by the paler or whiter colour of their flesh; and sardines and sprats by the flesh being white. The genuine fish may also be known by the pickle, after repose or filtration, being of a clear pinkish colour, without any red sediment; whilst that from spurious kinds is turbid and red only when agitated, and deposits a heavy red sediment (Armenian bole, Venetian red, or red ochre) on repose. See BUTTER, POTTING, POWDERS, SAUCES, &c.

Anchovies, Brit'ish. See SPRATS.

ANCHU'SIC ACID (-ku'-zik). See ANCHUSINE.

ANCHU'SINE (-kū-zĭn). [Eng., Fr.] *Syn.* ANCHU'SIC ACID*, PSEU'DO-ALKANN'INE*, PSEUDO-ALKA''-NIUM*; ANCHUSI'NA, L. The resinoid constituting the colouring matter of alkanet-root (which *see*).

ANCHYLO'SIS (ăngk-e-). [L.; prim., Gr.] *Syn.* ANKYLO'SIS, ANCYLO'SIS (ăn-se-), L.; ANKYLOSE, Fr., Ger. In *pathology*, stiffness or immobility of a joint naturally moveable. Anchylosis is either true or complete, as when the extremities of the bones forming a joint are united and immoveable; or false, or incomplete, where the affection depends upon a contraction of the tendons and ligaments surrounding the joints, which nevertheless admit of a small degree of motion. For the first there is no available remedy; for the second gentle and progressive flexion and extension of the part daily (carefully avoiding violence), friction with oleaginous and stimulating liniments, and the use of the hot bath, vapour bath, or hot-air or Turkish bath, and electricity have been strongly recommended, and have frequently proved successful.

ANDAMAN MARBLE WOOD (*Diospyros Kurzii*, Hiern.). The tree grows to a height of about 60 feet, and is a native of the Andaman Islands, and the Nicobars. This splendid wood is not known in commerce, though the trees seem to be abundant, and the wood much used in the country of its growth for furniture, handles, and sheaths of blades, &c.

ANDIRA ARAROBA, Aguiar. See ARAROBA.

ANDITROPFEN (*Kirchner* and *Menge Arolsen*), for weak digestion. Senna, 20 parts; rhubarb, 3 parts; jalap, 6 parts; zedoary root, 2 parts; ginger, 2 parts; galangal, 3 parts; soda, bicarbonate, 5 parts; sugar, 15 parts; water, 300 parts; spirit, 65 parts. After digestion this is to be strained and mixed with an infusion of 30 parts of yarrow (with the flowers) in 300 parts of hot water. After standing some time, filter (*Hager*).

ANDROGRAPHIS PANICULATA. (Ind. Ph.) *Syn.* KARIYÁT. *Habitat.* Commonly in shady places all over India.—*Officinal Part.* The dried stalks and root (Andrographis Caules et Radix, Kariyát, Creyat). The stem, which is usually met with, with the root attached, occurs in pieces of about a foot or more in length, quadrangular, of a lightish-brown colour, and persistent bitter taste. —*Properties.* Bitter tonic and stomachic, very analogous to quassia in its action.—*Therapeutic Uses.* In general debility, in convalescence after fevers, and in the advanced stages of dysentery.

Preparations:

Compound Infusion of Kariyát (Infusum Andrographis compositum). Take of Kariyát, bruised, ½ oz.; orange-peel and coriander fruit, bruised, of each, 60 gr.; boiling water, 10 fl. oz. Infuse in a covered vessel for an hour and strain.—*Dose.* From 1½ to 2 fl. oz., twice or thrice daily.

Compound Tincture of Kariyát (Tinctura Andrographis composita). Take of kariyát root, cut small, 6 oz.; myrrh and aloes, in coarse powder, of each 1 oz.; brandy, 3 pints. Macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient brandy to make two pints.—*Dose.* From 1 to 4 fl. dr. Said to be tonic, stimulant, and gently aperient, and to prove valuable in several forms of dyspepsia, and in torpidity of the bowels.

ANDROPOGON (CYMBOPOGON) CITRATUM. Lemon Grass. (Ind. Ph.) *Habitat.* Commonly cultivated in gardens in India; also in Ceylon, upon a large scale, for the sake of its volatile oil.—*Officinal Part.* The volatile oil (Oleum Andropogi Citrati, Lemon Grass Oil, Oil of Verbena), obtained by distillation from the fresh plant; of a pale sherry colour, transparent, extremely pungent taste, and a peculiar fragrant lemon-like odour.—*Properties.* Stimulant, carminative, antispasmodic, and diaphoretic; locally applied, rubefacient. — *Therapeutic Use.* In flatulent and spasmodic affections of the bowels, and in gastric irritability. In cholera it proves serviceable by aiding the process of reaction. Externally, as an embrocation in chronic rheumatism, neuralgia, sprains, and other painful affections.

Dose. From 3 to 6 drops, on sugar or in emulsion. For external application it should be diluted with twice its bulk of soap liniment or any bland oil.

ANDROPOGON (CYMBOPOGON) NARDUS. CITRONELLE. (Ind. Ph.) *Habitat.* Madras Peninsula and Ceylon. The volatile oil of this plant has similar properties to *A. citratum,* and is used for the same purposes.

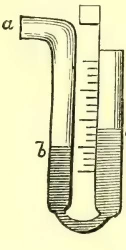
ANDROPOGON PACHNODES. (Ind. Ph.) The volatile oil of this plant possesses similar properties to that of *A. citratum,* and is used for the same purposes.

All the above Andropogon or Indian Grass oils are much used by soap makers and perfumers. One variety from *Andropogon schœnanthus* is largely used for adulterating attar of rose.

ANELECTRIC (ăn-e-). Non-electric; a non-electric.

ANEMOM'ETER (ăn-e-). *Syn.* ANEMOM'ETRUM, L.; ANÉMOMÈTRE, Fr.; WINDMESSER, Ger. An instrument or apparatus for measuring the force or velocity of the wind, or of a current of air. Various contrivances have been adopted for this purpose. The oldest pressure anemometer is that of Dr Lind. This instrument is also applicable to the determination of the draught of a chimney, and the strength of air-current in ventilation.

Uses and Appl. The open end (*a*) is kept, by means of a vane, presented to the wind, which acting on the surface of the water, or other liquid in *b*, raises the level of the fluid in the arm (*c*). The difference of the level of the fluid in the two arms of the instrument is the measure of the force of the wind. To estimate the draught of a flue or chimney, the arm (*c*) is placed in the chimney, and the orifice (*a*) in the apartment. The indications of this instrument are necessarily very rough.



Anemometers are of two classes; those which record *force* or pressure, and those which record *velocity*.

For meteorological purposes Lind's instrument is of little or no use. Until recently the best pressure anemometer was Osler's, which consisted of a broad arm capable of rotating on a vertical axis, and so arranged as to press as it turned against a series of springs. The motion was communicated to a pencil, and the results recorded continuously on a moving band of paper. The liability of the spring to rust from exposure to the weather, and consequently to vary in strength, made the results after a time unreliable. Cator's pressure anemometer is freed from this defect by the use of a system of levers instead of springs. The only part exposed to the weather is the pressure plate, so that the chance of damage from this cause is diminished. Further, the plate has a conical back, to obviate the effect of the vacuum caused behind such a plate by a strong wind. The Vienna Congress recommended the use of Wild's pressure gauge, which is simply a plate suspended freely on hinges, the angle which it makes with the vertical indicating the force of the wind. The results obtained are fairly accurate for light winds, but the same plate will be kept almost horizontal by a 'moderate breeze' (6 or 7 on Beaufort's scale). See METEOROLOGY.

Velocity Anemometers. Practically the only form in use is Robinson's, which is fitted with 4 hemispherical cups fixed to the arms of a cross. The rate of revolution of these is recorded, and the velocity of the wind can be calculated from it. The indications are usually 15% to 20% below the correct figures, and a larger instrument gives slightly too high results, though theoretically the size of the instrument should produce no difference.

All anemometrical observations are very unsatisfactory, and it appears to be almost impossible to compare results obtained at different stations, so great is the influence of position of the instruments upon the records obtained.

ANEMOM'ETRY. *Syn.* ANEMOME'TRIA, L.; ANÉMOMETRIE, Fr.; WINDMESSEN, Ger. In *meteorology, physics*, &c., the art or act of measuring the velocity or force of the wind, or of ascertaining its direction.

ANEM'ONE (ă-nĕm'-o-ne). *Syn.* ANEM'ONY; ANEM'ONE, L., Ger; ANÉMONE, Fr. The windflower. In *botany*, a genus of beautiful flowering herbaceous plants, of the Nat. Ord. RANUNCULACEÆ. The double flowers of some of the species are among the most elegant ornaments of our gardens. Others are used in medicine. They are all acrid and stimulating.

Anemone pulsatilla, L. Pasque-flower. Mr L. Castle suggests that this beautiful plant might be more generally cultivated. He directs that the seed be sown in August "in pans or pots of light sandy soil, placed either out of doors or in a cold frame. The young plants can then be transferred in the following spring to their permanent quarters. Select a rather warm position and deep well-dug soil, light loam being the best, with a good natural drainage, as the plant is very impatient of stagnant moisture, being found in a natural state on open hills in dry soils. The plant can be increased by division of the roots in autumn or early spring, the latter being preferable in favorable seasons, though sometimes the flowering is liable to be checked for that season."

ANEMONE, SEA-. Marine animals belonging to the class Actinozoa, of very varied colour, and when fully expanded having a certain resemblance to a flower, from which circumstance they are often called sea-flowers.

The animal consists of a more or less cylindrical body by the lower part of which it attaches itself to the rock; in the centre is a cavity which may be called the gastric cavity, from the sides of which radiate partitions or 'mesenteries,' dividing the sac into a corresponding number of '*intermesenteric chambers*.' The oval aperture is surrounded by tentacles which can be protruded or retracted at the will of the animal.

ANEMON'IC ACID. See ANEMONIN.

ANEMONIN. A crystalline substance found in the leaves of several species of anemone, viz. *A. pulsatilla, A. pratensis, A. nemorosa.* Water distilled from these leaves, after some weeks, deposits a colourless, inodorous substance, which softens at 150° C., giving off water and acrid vapours. It is purified by repeated crystallisation from boiling alcohol. Anemonin is a poisonous body. It causes slight irritation when applied to the skin. By the action of alkalies anemonin is transferred into anemonic acid. M. Bronevski recommends its use in bronchitis, convulsions, cough, and asthma.—*Dose.* $\frac{1}{50}$ to $\frac{1}{10}$ gr.

ANEM'OSCOPE (ăn'-e—*Brande, Mayne*). *Syn.* ANEMOSCO'PIUM, L.; ANÉMOSCOPE, Fr.; ANEMOSKOP, Ger. An instrument to measure the force and velocity of the wind. See ANEMOMETER.

AN'EROID (-royd). In *physics*, &c., not fluid, or not depending on water or a fluid for its action; applied to a certain form of barometer (which *see*).

ANEURISM. A local dilatation of an artery, leading to the formation of a tumour which contains blood, and the walls of which are composed either of the tissues of the vessel, or those which form its sheath or immediately surround it. Therefore every aneurism properly so called consists of two parts—a sac and its contents.

ANGELIC ACID. $C_5H_8O_2$, = $C_4H_7CO_2H$. An acid present in the angelica root (*Buchner*) and in oil of camomile. It crystallises in monoclinic prisms or needles, and has a peculiar aromatic odour, and sour but aromatic taste. M. Pt. 45°.

ANGEL'ICA (-jĕl'-). [L., Port., Sp.; Ph. E. & D.] *Syn.* GARDEN ANGELICA; ANGELIQUE, Fr.; ANGELIKA, A.-WURZEL, ANGELKRAUT, Ger. The *Angelica archangel'ica* of Linnæus, an aromatic herbaceous plant with a biennial, fleshy root, indigenous to the north of Europe, but frequently found wild in England, and largely cultivated in our gardens. Dried root (ANGELICA, Ph. E.), aperient, carminative, diaphoretic, and tonic; much esteemed by the Laplanders, both as food and medicine;—fruit or seed (ANGELICA, Ph. D.) resembles the root, but is weaker. The whole plant has been extolled as an aromatic tonic. As a masticatory, it leaves an agreeable glowing heat in the mouth. The aromatic properties of this plant depend on a peculiar volatile oil and resin.

Uses, &c. It has been recommended in diarrhœa, dyspepsia, debility, and some fevers; but is now seldom used in medicine.—*Dose,* 30 gr. to 1 dr. The dried root and seeds are used by rectifiers to flavour gin and liqueurs; and the fresh root, tender stems, stalks, &c., are made by the confectioners into an aromatic candy. See CANDYING, LIQUEURS, &c.

Angelica atropurpu''rea. [Linn.] *Syn.* AMER'ICAN ANGELICA; ANGELICA, Ph. U. S. *Hab.* North America. Resembles garden angelica, but placed by some botanists in a separate, though allied genus. It is a popular remedy for flatulent colic, indigestion, and cardialgia, in the United States; and is there regarded as tonic, cordial, and aphrodisiac.

ANGO'LA. *Syn.* ANGO'LA-WOOL, ANGO''RA-W., ANGO'NA-W., &c.; POIL DE CHEVRON D'ANGORA, Fr.; (Engoor', Engour', or Engu'ri) TIFTIC, Tur. The wool of *Ca'pra angoren'sis,* or the Angora goat, of which the shawls of Cashmere are made, and others in imitation of them. It is also used to make plush, light cloths for palelôts which are repellent of wet, &c.; and is extensively employed in France in the manufacture of lace more brilliant than that of Valenciennes and Chantilly, and at half the price. See ALPACA, SHAWLS, WOOL, &c.

ANGOSTU'RA, Angustu'ra. (-tūre'-ă). See CUSPARIA.

Angostura, False. See BRUCIA, CUSPARIA, and STRYCHNOS.

ANGOSTU''RINE, Angustu'rine (-ĭn). See CUSPARIN.

ANHYDRIDES. "Oxides which react with water to form acids, or are obtained from acids by withdrawing water, or which react with basic oxides to produce salts" ('Watt's Dict. of Chem.,' Second Edition). Examples: Sulphuric anhydride, SO_3; Nitric anhydride, N_2O_5 (sometimes called, in old books on chemistry, anhydrous sulphuric and anhydrous nitric acids).

$$SO_3 + H_2O = H_2SO_4,$$
$$SO_3 + BaO = BaSO_4,$$
$$N_2O_5 + H_2O = 2HNO_3,$$
$$N_2O_5 + BaO = Ba(NO_3)_2, \text{ \&c., \&c.}$$

Most of the oxides of the non-metals are anhydrides, while the most positive elements, *e.g.* potassium, do not form them. Chromic anhydride, CrO_3, may be taken as an example of a metallic anhydride. The term is now hardly ever applied to base-producing oxides such as potassic oxide, K_2O, although it used to be. Those anhydrides which are of technical importance will be found described in their proper order. For a description of *Organic anhydrides* the reader is referred to 'Watt's Dictionary.'

ANHY'DROUS. *Syn.* ANHYDRUS, L.; ANHYDRÉ, Fr.; WASSERFREI, Ger. This term is applied in chemistry and mineralogy to substances which have been freed from chemically combined water; *e.g.* anhydrous sulphate of copper has the composition $CuSO_4$, the ordinary hydrated sulphate being $CuSO_4 + 5H_2O$. Substances containing uncombined water should be referred to as moist, not hydrated. Hydrated salts can usually be rendered anhydrous, either by exposure to a dry atmosphere at the ordinary temperature, or by cautious heating.

AN'IL. [Fr., Sp., L.] The *Indigof'era anil* of botanists—one of the plants yielding 'indigo'—a native of America, but now largely cultivated in the East Indies. See INDIGO (and *below*).

AN'ILINE. [Eng., Fr.] C_6H_7N. *Syn.* Phenyl'-amine, Amido-benzene; Anilina, Anili'num, &c., L. A peculiar volatile base, first noticed by Unverdorben in 1826 amongst the products of distillation of indigo. He named it 'Crystalline,' from the ease with which it united with acids to form crystalline salts. In 1834 Runge found a volatile base in coal-tar oil, which gave a blue colour with bleaching-powder, and which he termed 'kyanol.' He also noticed that it coloured pine-wood yellow. In 1840 Fritzsche examined the compounds produced by distilling indigo with caustic soda, and isolated a body, C_6H_7N, which he named Aniline, from *anil* (*nila,* Indian, blue; *anil,* Arabic, the blue), the name under which the Portuguese introduced indigo. Lastly, in 1842 Zinin observed that an ammoniacal alcoholic solution of nitro-benzene could be reduced by sulphuretted hydrogen to an oily base, C_6H_7N, which Fritzsche recognised as aniline. The identity of the last three bodies was proved experimentally by Hofmann in 1843, who proposed the name of phenylamine for the new base, because of its being a derivative of ammonia. Griess afterwards proposed the name amidobenzene.

Manuf. and *Prep.* Aniline—as mentioned above—occurs in coal-tar, but the quantity is too small to allow of its being extracted from this source. The aniline is removed when the crude distillate is treated with acid in the course of its purification. (See COAL-TAR DISTILLATION). On the large scale it is always manufactured by the action of a reducing agent on nitro-benzene (which *see*). In Zinin's method, mentioned above, the reaction would be:

$$C_6H_5.NO_2 + 3H_2S = C_6H_5.NH_2 + 2H_2O + S_3.$$

A great number of reducing agents can and have been used for the reduction of nitro-benzene. The following is a list of the most important:

Alcoholic sulphuretted hydrogen (*Zinin*).
Acetic acid and metallic iron (*Béchamp*).
Zinc and alcoholic hydrochloric acid (*Hofmann*).
Zinc dust and hot water (*Kremer*).
Tin and hydrochloric acid (*Scheurer Kestner*).
Hydriodic acid at 104° C. (*Mills*).
Caustic soda and grape sugar (*Vohl*).
Alkaline arsenites (*Wöhler*).

Stannous chloride (*Kekulé*).

Iron filings and very dilute hydrochloric acid (*Brimmeyr*).

Water and iron coated with copper by immersion in a solution of copper sulphate (*Coblenz*).

Water and an ammoniacal solution of cuprous oxide (*Wagner*).

Of these different reducing substances, the mixture of iron filings and acetic acid was soon found to be the most suitable. Latterly the acetic acid has been replaced by dilute hydrochloric acid, which is less costly.

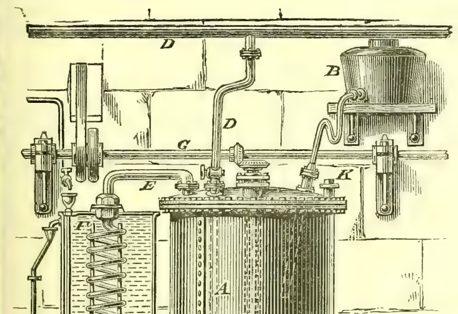
The first reaction which takes place is:

$$C_6H_5NO_2 + 3Fe + 6HCl = C_6H_5NH_2 + 3FeCl_2 + 2H_2O;$$

the ferrous chloride in the presence of acid is itself a reducing agent, and deoxidises a further quantity of nitro-benzene:

$$C_6H_5.NO_2 + 6FeCl_2 + 6HCl = C_6H_5NH_2 + 3Fe_2Cl_6 + 2H_2O.$$

The ferric chloride in the presence of the aniline already formed is next decomposed by the water, with formation of ferric oxide and hydrochloric acid, the latter combining with the aniline. Lastly, the aniline hydrochloride so formed reacts with iron and nitro-benzene exactly like hydrochloric acid, forming aniline and ferrous chloride. Hence theoretically a small amount of acid in the presence of iron should suffice to convert a large quantity of nitro-benzene into aniline, and in practice much less than the equivalent proportion of acid is used. The reduction of nitro-benzene is carried out in the apparatus shown in the figure. It consists of a



cylindrical cast-iron vessel A, made in two halves and bolted together so that the lower half, which is most acted upon by the acid, may be frequently replaced. It is provided with a stirring arrangement, a reservoir B for nitro-benzene, a man-hole for the introduction of iron-filings, and an exit-tube E by which the vapours produced are led to a condenser, and so recovered. The stirrer and spindle are made hollow, and are connected with a steam supply which furnishes the necessary heat, and also assists the agitation. At starting, 40 parts of water, 25 of finely divided cast-iron filings, and 8 to 10 parts of hydrochloric acid are placed in the vessel, and 100 parts of nitro-benzene gradually added, the stirrer being kept in motion and steam blown in. As soon as the first violent reaction is over, a further addition of 75 parts of damp iron filings is gradually made. If the filings are added too rapidly, the reduction is apt to go too far, benzene and ammonia being produced. Finally, when the reaction has again moderated, 10–20 parts of dry filings are added, and steam blown in until the reduction is complete, any nitro-benzene which distils over being returned to the vessel. The residual mass now consists of a mixture of aniline, aniline hydrochloride, and ferric oxide. In order to separate the aniline lime is added, and the mixture distilled with high-pressure steam so long as anything comes over. The distillate consists of two layers, viz. aniline and water. The latter contains 2% to 3% of aniline, and is employed for producing steam for a second operation.

If the benzene used for preparing the nitrobenzene for the above process is pure, the aniline will also be pure. But if the less pure commercial benzenes (containing higher homologues of benzene, viz. toluenes, xylenes, &c.) be used, the aniline will contain the amido-derivatives of these bodies, viz. the toluidines, xylidines, &c. Formerly the commercial anilines were very impure, consisting as they did of mixtures of aniline and toluidines, &c. Now, however, it is the practice to effect a virtually complete separation between the benzene and toluenes of the crude light-oils, this being rendered possible by the use of more perfect apparatus for fractional distillation (see COAL-TAR DISTILLATION). The aniline and toluidines produced from these are mixed at the dye-works in the proportions required.

Of other processes proposed for the manufacture of aniline, may be mentioned the reduction of nitro-benzene by means of the nascent hydrogen evolved in the electrolysis of dilute sulphuric acid, and the reduction of nitro-benzene or di-nitrobenzene (forming phenylene-diamine) by heating with a mixture of carbon disulphide and ammonia, the residue after removal of aniline being worked up for ammonium sulphocyanide. The reducing agents here are obviously ammonium sulphide and sulphuretted hydrogen. A very interesting attempt has been made to convert phenol into aniline by heating with ammonium chloride, thus:

$$C_6H_5(OH) + NH_4Cl = C_6H_5NH_2.HCl + H_2O;$$

but hitherto the yield has not been sufficient to render the process practically successful.

For laboratory purposes nitro-benzene is best reduced by means of tin and hydrochloric acid. The nitro-benzene, with excess of tin and acid, is placed in a flask fitted with a reflux condenser, and the reaction assisted by gentle warming over the water-bath. When all the nitro-benzene has gone into solution, the dissolved tin is removed by means of sulphuretted hydrogen, and the solution of the hydrochlorate either evaporated to the crystallising point, or distilled with potash or soda in a current of steam; the supernatant aniline is separated by means of a tap-funnel, dried with fused calcium chloride, and re-distilled, the portion which passes over at 184° C. being collected apart. A further purification can be effected by converting the aniline into aniline oxalate, and recrystallising

several times, the aniline being afterwards liberated by potash, dried, and distilled.

Properties. Aniline is a colourless oily liquid at the ordinary temperature, boiling at 182°—183° C. (359·6°—361·4° F.), and solidifying at −8° C. (17·6° F.). It has strong basic properties, and may be considered as ammonia, NH_3, in which an atom of hydrogen has been replaced by the group phenyl, C_6H_5; or as benzene, C_6H_6, in which an atom of hydrogen has been replaced by the group NH_2. It forms the lowest of a series of bases derived from the homologues of benzene, by the replacement of an atom of hydrogen in the benzene ring by NH_2. The next lower members of this series, the toluidines, are of equal commercial importance with aniline, and are generally produced along with it in the reduction of the nitro-compounds prepared from commercial benzene.

Exposed to the air aniline soon acquires a brown colour (probably due to oxidation), and eventually becomes resinous. The colour may be removed by passing sulphuretted hydrogen through the liquid (*Hugouneng*).

The specific gravity of aniline is 1·03790 at 0° C. (32° F.); 1·02763 at 11·63° C. (52·93° F.); compared with water at 4° C. (39·2° F.). At its boiling-point it is 0·87274 (*Thorpe*). The lowest specific gravity observed in commercial aniline (for the manufacture of aniline blue) is 1·0267. Water and aniline do not mix in all proportions at ordinary temperatures and pressures, but separate into two layers. Water dissolves at 16° C. 3·11%, at 56° C. 3·58%, and at 82° C. 5·18% aniline. Aniline dissolves at 0° C. 4·58%, at 25° C. 4·98%, at 39° C. 5·43%, and at 68° C. 6·04% water (*Alexejew*). Aniline dissolves in a 50% solution of aniline hydrochlorate in all proportions. A solution of this of sp. gr. 1·08 has been sold as aniline, which it very much resembles in colour and odour. A soap solution containing 125 grms. soap per litre dissolves 125 grms. aniline.

Aniline is easily soluble in alcohol, ether, benzene and other hydrocarbons, and volatilises with steam. It dissolves aniline salts and toluidine, also sulphur, phosphorus, resins, indigo, and many other substances, and is frequently used as a solvent for organic compounds, in order to purify or crystallise them. Aniline is easily combustible, has an aromatic smell, a burning taste, and is poisonous. When inhaled it produces giddiness and cyanose (blueness ?) of the lips ('Anilinfarben,' *Heumann*). It is precipitated by alkalies from solutions of its salts in the form of an easily decomposable hydrate. Aniline is liberated from its salts by ammonia in the cold, but at a boiling temperature ammonium salts are decomposed by aniline.

Aniline (and toluidine) are neutral to litmus paper; they are basic to methyl-orange as indicator, but the results are not sharp (*Lunge*). The percentage of aniline in solutions of its neutral salts can be estimated by titration with standard alkali, using phenol-phthaleïn or rosolic acid as an indicator; the red colour does not appear until all the aniline has been liberated. The blue colour, produced on adding acids to the azo-dye stuff known as Congo-red, is changed to red by aniline and toluidine, hence this colour can be employed as an indicator for determining the amount of the base in water which has been used for washing aniline.

Aniline can be detected by adding a solution of bleaching-powder to its aqueous solution, a blue colour being produced (a mauve colour appears if toluidine be also present). The three toluidines alone give only brown colorations. The sensitiveness of this reaction is considerably increased if ammonium sulphide is added, a rose-red colour (rhodeïn) being produced. 1 part aniline in 250,000 parts of water can be detected in this way. The test is much less sensitive if ammonia or ammonium salts be present, unless a large excess of bleaching-powder solution is added. Admixed nitro-benzene can easily be detected in aniline by adding dilute acid until all the aniline is dissolved, when the insoluble nitro-benzene will be left behind in yellow globules, easily recognisable by their odour.

For the examination of aniline salts, Rowland and Williams ('Chem. News,' 50, 299) recommend the following tests: (1) Examination for insoluble substances by solution in water; (2) estimation of percentage of acid by titration with standard soda solution; (3) determination of the purity of the base by liberating it and digesting with arsenic acid at 180° C. (356° F.), when, if toluidine be present, a red colour will be produced.

Valuation of Commercial Aniline Oils. Since, in the manufacture of many dyes, the best and most economical results are obtained by using mixtures of aniline and toluidines of fixed proportion, the estimation of these constituents in commercial aniline oils becomes of importance. This valuation is usually effected by a fractional distillation, or by determining the specific gravity of the mixture.

Determination of Percentage of Ortho- and Para-toluidine in a Mixture of the same.—The specific gravity is taken with great accuracy, preferably by means of the pyknometer or by means of a large areometer (see SPECIFIC GRAVITY, DETERMINATION OF). The temperature must be noted exactly, since a difference of 1° C. makes an error of 7% in the result. For every ± degree C. of difference between the observed and tabular temperature, a correction of ∓ 0·0008 must be made when the observed sp. gr. is above 1·0008; when below, a correction of ∓ 0·0007 is requisite. The percentage of *o*-toluidine corresponding to the corrected sp. gr. is found from the following table:

Percentage Composition of Mixtures of Ortho- and Para-toluidine of given Specific Gravity at 15° C. (59° F.), compared with Water at the same Temperature.

Sp. Gr.	Ortho-toluidine Per Cent.	Sp. Gr.	Ortho-toluidine Per Cent.
1·0037	100	1·0031	94
1·0036	99	1·0030	93·5
1·0035	98	1·0029	92·5
1·0034	97	1·0028	91·5
1·0033	96	1·0027	91
1·0032	95	1·0026	90

Sp. Gr.	Ortho-toluidine Per Cent.	Sp. Gr.	Ortho-toluidine Per Cent.
1·0025	89·5	1·0005	73
1·0024	88·5	1·0004	72
1·0023	88	1·0003	72·5
1·0022	87	1·0002	71
1·0021	86·5	1·0001	70
1·0020	86	1·0000	69
1·0019	85	0·9999	68·5
1·0018	84·5	0·9998	68
1·0017	83·5	0·9997	67
1·0016	82·5	0·9996	66·5
1·0015	82	0·9995	65·5
1·0014	81	0·9982	56
1·0013	80	0·9981	55
1·0012	79·5	0·9980	54·5
1·0011	78·5	0·9979	54
1·0010	77·5	0·9978	53
1·0009	77	0·9977	52·5
1·0008	76	0·9976	51·5
1·0007	75	0·9975	51
1·0006	74	0·9974	50

When the percentage of *p*-toluidine is greater than 50, the liquid becomes too thick at 15° C. for a determination of the specific gravity; it must therefore be taken at a higher temperature.

The following table gives specific gravities and corresponding percentages for a temperature of 20° C. (68° F.):

Sp. Gr.	Ortho-toluidine per Cent.	Sp. Gr.	Ortho-toluidine per Cent.
0·9939	50	0·9932	45
0·9938	49·5	0·9931	44·5
0·9937	48·5	0·9930	44
0·9936	48	0·9929	43
0·9935	47·5	0·9928	42
0·9934	46·5	0·9927	41
0·9933	46	0·9926	40

The above method gives results correct to within 2%, which is sufficiently accurate for practical purposes.

Mixtures of aniline with *o*- or *p*-toluidine may be analysed by determining the specific gravity, as before, and then obtaining the percentage composition (by volume) from the following data:

Sp. gr. of aniline at 1·0° C. = 1·0377.
„ *o*-toluidine at 0·8° C. = 1·0145.
„ *p*-toluidine at 0·0° C. = 1·0053.

Thus, in an analysis of a mixture of aniline and *o*-toluidine (the '*Echappées*' in fuchsin manufacture), let a be the observed sp. gr., y = the number of cubic centimetres of *o*-toluidine in 100 of the mixture, then:

$$y = \left(\frac{1{\cdot}0377 - a}{1{\cdot}0377 - 1{\cdot}0145}\right) 100$$

A similar formula holds for a mixture of any two of the above three constituents.

The old method of Reimann is more readily carried out, but gives less accurate results. 100 c. c. of the sample is slowly distilled from a retort or *Wurtz*-flask fitted with a thermometer, and the amounts which pass over, for every rise of 5° C. (9° F.) in the boiling point, noted. The result is compared with the following table, constructed by Reimann from data obtained by distilling different mixtures of light aniline (called by him kuph-aniline) and heavy aniline (baraniline).

CENTIGRADE . . .	K. 100 B. 0	90 10	85 15	80 20	75 25	60 40	50 50	25 75	0 100
Below 180° . . .	8½	7	2½	5½	7	...	7	5½	...
180°—185° . . .	54	50	29½	22	5½	7	4½	2½	2
185°—190° . . .	34	34	56½	55½	55½	37	7½	4½	1½
190°—195° . . .	...	5	7½	8½	15	33	42	17	8
195°—200° . . .	...	...	...	...	9	...	19	36	18
200°—205° . . .	...	...	...	...	4½	16	10	16	39
205°—210° . . .	...	...	...	...	...	...	3½	8	19
210°—215° . . .	...	...	...	...	...	...	...	4½	7
Residue	3½	4	4	8½	3½	7	6½	5	5½

Häussermann ('Dingl. Journ.,' 1878, 228, p. 179) states that technical 'pure' aniline should distil within a range of 1½°—2° C., and have a sp. gr. of 1·0245 at 15° C.; toluidine should boil within 3°—3½° C.; aniline oil for red should distil within a range of 10°—12° C., should have a specific gravity of 1·004 to 1·006, and should contain 10% to 20% aniline, 25% to 40% *p*-toluidine, and 30% to 40% *o*-toluidine; aniline for safranine should contain about 35% aniline, the rest being toluidine. It should have a sp. gr. of 1·016, and a B. Pt. of 185°—190° C. More recently the same authority states that, in almost all factories where the arsenic acid method is carried out, a red oil is used, which is made by mixing 1 part of aniline with 2 parts of toluidine, has a sp. gr. of 1·008, and boils at 190°—198° C. (374°—388° F.). Since toluidine almost always contains 36% of the *p*-compound, the composition of the above red oil will be 33·3% aniline, 24·0% *p*-toluidine, and 42·7% *o*-toluidine.

As we have already seen, it is now not unusual to prepare practically pure aniline and toluidine. The latter consists mainly of the *o*- and *p*-

compounds, which it is sometimes necessary to separate. This cannot be done by fractional distillation, but may be effected by fractional neutralisation.

For this purpose the composition of the mixture is determined, as above, and a quantity of sulphuric or oxalic acid, sufficient to combine with the *p*-toluidine only, added. The acid combines almost entirely with the latter, and the uncombined *o*-toluidine can be distilled over by steam. The *o*-toluidine still contains a little of the *p*-compound, but may be rendered practically pure by a repetition of this process. The *p*-compound can be liberated from its salt by the addition of alkali.

Bindschedler ('Ber. der Deutsch. Chem. Gesellschaft,' 1873, vi, 448) gives the following directions:

Ten kilos. toluidine are mixed with 25 litres of water, 2·5 kilos. oxalic acid, and 6 litres of hydrochloric acid of 20° B., and the mixture heated to boiling and then cooled to 60° C. under stirring. Para-toluidine oxalate crystallises out and is rapidly filtered off, washed, treated with alkali, and the separated *p*-toluidine distilled. To the cooled filtrate is added another 2 kilos. of oxalic acid, with stirring, when a mixed precipitate of *p*- and *o*-toluidine oxalates falls. This is separated and worked up with the next lot of toluidine, whilst the completely cooled filtrate—which should not give a precipitate with concentrated oxalic acid—is decomposed with soda and distilled, by which means pure *o*-toluidine is obtained.

Uses. Aniline and its higher homologues have become of enormous importance in the arts, as they form the starting-point for the greater number of the artificial dyes which have now practically displaced natural dye-stuffs. It is also occasionally used as a solvent.

Salts of Aniline. Aniline dissolves in dilute acids, combining with them to form neutral salts, which crystallise readily. The following are the more important commercial salts; they are used chiefly in the manufacture of dyes:

Aniline hydrochlorate (aniline hydrochloride), C_6H_7N, HCl. Prepared by dissolving aniline in a slight excess of dilute hydrochloric acid and evaporating to the crystallising point. Colourless needles or leaves, M. Pt. 192° C. (377·6° F.); easily soluble in water and alcohol. Sp. gr. 1·2215 at 4° C.

Aniline nitrate, C_6H_7N,HNO_3.

Aniline phosphate, $(C_6H_7N)_2, H_3PO_4$. Leafy crystals, easily soluble in water, hot alcohol and ether; difficultly soluble in cold alcohol. Aniline sulphate $(C_6H_7N)_2,H_2SO_4$. Sp. gr. 1·377 at 4° C. Easily soluble in water, difficultly soluble in absolute alcohol, insoluble in ether.

Aniline oxalate, $(C_6H_7N)_2,H_2C_2O_4$. Triclinic prisms. Solubility the same as that of the sulphate.

The above four salts may be prepared like the hydrochlorate, by saturating solutions of the acids with aniline and evaporating. Or they may be precipitated from an alcoholic solution of aniline by adding the acids dissolved in alcohol.

Platinum double chloride, $(C_6H_7N,HCl)_2,PtCl_4$. Precipitated by mixing strong solutions of aniline hydrochloride and platinic chloride. Crystallises from dilute or warm solutions in yellow needles. Aniline also combines with many metallic salts, forming crystalline compounds; thus, a compound, $HgCl_2,2C_6H_7N$, is precipitated by mixing alcoholic solutions of aniline and mercuric chloride.

ANILINE DYES. Some of the more important of these will be considered individually (see the various colours).

ANILINE POISON. Articles dyed with aniline compounds are apt to produce an intense form of inflammation and vesication of the skin, which is rebellious against treatment and liable to relapse for many months after the original attack has subsided.

ANIMAL'CULE (kūle). [Eng., Fr.; pl. animal'cules.] *Syn.* ANIMAL'CULUM (pl. animal'cula), L.; THIERCHEN, Ger. Animalculæ for the plural, sometimes heard and met with, is a barbarism; yet one not wholly confined to the vulgar, for we find it in Vincent's edition of Haydn's admirable 'Dict. of Dates,' not merely twice, or oftener, in the text, but as a 'title-word;' and also in some other works where we might least expect it. In *zoology* and *physiology*, a microscopic animal, or one so extremely small that it is either invisible, or not distinctly discernible, without the aid of a lens or microscope; more especially one that is not perceptible to the naked eye. "A mite was anciently thought the limit of littleness; but there are animals 27,000,000 of times smaller than a mite." A thousand millions of some of the animalcula found in common water are said to be collectively of less bulk than a single grain of sand; yet their numbers are so prodigious as sometimes to give the fluid they inhabit a pale red or yellow tinge. The milt of a single codfish is said to contain more of these minute animals than there are people in the whole earth. Animalcula were first scientifically observed by Leuwenhoek about the year 1677. Assisted by the microscope he unveiled, as it were, a new world for future naturalists and microscopists to explore.

"Take any drop of water," says Professor Rymer Jones, "from our rivers, from our lakes, or from the vast ocean itself, and place it under the microscope, you will find therein countless living beings moving therein in all directions with considerable swiftness, apparently gifted with sagacity, for they readily elude each other in the active dance they keep up. . . . . Increase the power of your glasses, and you will soon perceive inhabiting the same drop other animals, compared to which the former were elephantine in their dimensions, equally vivacious and equally gifted. Exhaust the art of the optician, strain your eyes to the utmost, until the aching sense refuses to perceive the little quivering movement that indicates the presence of life, and you will find that you have not exhausted nature in the descending scale."

Amongst the most remarkable discoveries of modern science must be reckoned that of fossil animalcules in such abundance as to form the principal part of extensive strata. This discovery is due to Ehrenberg, who found the Polierschiefer (the polishing slate or tripoli) of Bilin to be almost entirely made up of the siliceous shields of a minute fossil animalcule, the length of one

of which is about $\frac{1}{288}$th of a line, so that about 23,000,000 of animalcules must have gone to form a cubic line, and 41,000,000,000 to form a cubic inch of the rock. Ehrenberg succeeded in discovering the formation of similar strata in deposits of mud at the bottom of lakes and marshes, the mud swarming with living animalcules, probably in their turn to be fossilised. The berg-mehl, or mountain meal of Sweden and other parts of Europe, which is sometimes used as an article of food, is entirely composed of the remains of animalcules; not merely, however, of their siliceous shields, for it contains a considerable percentage of dry animal matter. Some animalcules prefer waters impregnated with iron, and their death gives rise to an ochreous substance in which iron is a principal ingredient.

AN'IME (ăn'-ĭm-e). [Eng., L., Sp.] *Syn.* GUM-COPAL, GUM-AN'IME, A.-RES'IN; ANIMÉ, Fr.; ANIMEHARZ, KOURBARILLHARZ, Ger.; COURBARIL, JUTAIBA, Nat. A pale brownish-yellow, transparent, brittle resin, supposed to be furnished by the *Hymenæa courbaril*, Linn., or locust-tree, the *H. martiana*, and other species of hymenæa growing in tropical America and the East Indies, but on no reliable authority. It contains about ·2% of volatile oil, which gives it an agreeable odour; melts without decomposition; is (nearly) insoluble in alcohol and in caoutchoucine, but forms a gelatinous mass in a mixture of the two (*Ure*). It burns readily, emitting a very fragrant smell.

There are various commercial varieties of copal. The produce, principally of *Trachylobium Hornemannianum*, Heyne, a tree of Zanzibar. The best anime is that which is dug from the ground near the roots of trees, or where the trees once stood, and is in a semi-fossil state. See COPAL.

Uses, &c. As a fumigation in spasmodic asthma; in solution as an embrocation; and in powder as a substitute for gum guaiacum. In this country it is chiefly employed to make varnishes and pastilles (which *see*).

AN'ION (-y'ŭn—Br., We.; ă-nī'-ŭn—Smart). Literally, 'upward going;' in *electro-chemistry*, a substance which is evolved from the surface where the electrical current is supposed to enter the electrolyte; an electro-negative body, or one which passes to the positive pole, or anode, in electrolysis, as opposed to a CATION. See ANODE, IONS, &c.

AN'ISATED. *Syn.* ANISA'TUS, L.; ANISÉ, Fr. In *pharmacy*, the art of the liqueuriste, confectioner, &c., applied to articles or preparations impregnated or flavoured with aniseed.

AN'ISE (-ĭs). *Syn.* ANI'SUM, PIMPINEL'LA A. (*Linn.*), A. OFFICINA'LE, L.; ANIS, Fr.; ANIS, GEMEINER ANIS, Ger. An annual plant of the Nat. Ord. UMBELLIFERÆ (DC.).—*Hab.* Egypt, Scio, and the Levant; but largely cultivated in Malta, Spain, Germany, and various other parts of Asia and Europe. "A considerable quantity is cultivated at Mitcham, in Surrey, chiefly for the use of the rectifiers of British spirits" (*Stephenson*). FRUIT, ANISEED. (See *below*.)

AN'ISEED. *Syn.* AN'ISE, AN'ISE-SEED; SEM'INA ANI'SI, FRUC'TUS A., L.; ANIS, A. VRAI, GRAINES D'ANIS, SEMENCE D'ANIS, Fr.; ANIS, ANISAMEN, Ger.; ANIS, Sp.; ANICE, It. The aromatic fruit or seed of the *Pimpinella anisum* just noticed.

Prop., Uses, &c. Its aromatic properties depend on the presence of volatile oil. The seed and oil, and an essence and a water prepared from them, are officinal in the pharmacopœias. Both the seed and its preparations are reputed stimulant, stomachic, carminative, pectoral, diuretic, and emmenagogue. They are commonly used to relieve flatulence and colicky pains, and to prevent the griping effects of certain cathartics; and they have long been popular remedies for coughs, colds, and other breath ailments. They are esteemed especially useful in warming the stomach and expelling wind, particularly during infancy and childhood; the distilled or flavoured water being usually employed. Nurses also take the latter to promote the secretion of milk, to which it at length imparts its peculiar odour and flavour. In *veterinary practice*, the powdered seed is used as a carminative, pectoral, and corrective. The essential oil is said to be poisonous to pigeons (*Vogel; Hillefield*). Aniseed is principally used to flavour liqueurs, sweetmeats, and confectionery.—*Dose* (of the powder), 10 gr. to 1 or 2 dr.; for a horse, $\frac{1}{2}$ to 1 *oz.*; cattle, $\frac{3}{4}$ to 2 *oz.*

Pur., &c. Powdered aniseed is nearly always adulterated, the adulterant being generally linseed meal. Sometimes, as for the horse, the latter is entirely substituted for it, a few drops of oil of aniseed being added to give it smell. The adulteration is not readily detected by the uninitiated, owing to the strong odour of aniseed; but readily by the microscope. The fruit of *Myrrhis odorata* (sweet cicely), and of *Illicium anisatum* (star-anise), also possess the odour and flavour of common aniseed; indeed, much of the essential oil now sold as 'oil of aniseed' is star-anise oil. See LIQUEURS, OILS, SPIRITS, WATERS, &c.

Anise, Star-. The fruit or seed of *Illi''cium anisa'tum*, Linn., an evergreen tree growing in China. This is an important variety of anise, yielding much of the oil of aniseed of commerce. The fruits are sometimes adulterated with the fruits of a closely allied tree called *Illicium religiosum*, a native of Japan; as the latter is poisonous, it is important to distinguish the two kinds of fruit, and Geerts has supplied the following: "The ends of the carpels of the Japanese fruit are pointed and curved upwards, whilst the apex of the star-anise is mostly pressed in and extended horizontally. The former are more woody and rough on the surface, also more compressed and more boat-shaped than the rosette-like star-anise, and enclose brighter seeds of a yellowish colour."

ANISETTE' (ăn-ĭz-ĕt'). [Fr.] Aniseed cordial. See LIQUEURS.

ANISOCHILUS CARNOSUM. Nat. Ord. LABIATÆ. An Indian plant. It is stimulant, diaphoretic, and expectorant; is used in quinsy, and by the native doctors of Travancore in catarrhal affections. Dr Bidie, an Indian practitioner, characterises it as a mild stimulating expectorant, and as such particularly useful in the coughs of childhood. Its properties depend upon a volatile oil.

ANISOMELES MALABARICA. An Indian plant. Nat. Ord. LABIATÆ. Few plants are held in higher esteem, or more frequently em-

ployed in native practice in Southern India, than this. An infusion made of the leaves is very generally used in affections of the stomach and bowels, catarrhal complaints, and intermittent fevers.

Dr Wright says that, in addition to its internal use in the case of fevers, patients are made to inhale the vapour of a hot infusion, so as to induce copious diaphoresis. An infusion of the leaves is reported to be powerfully diaphoretic, and to have been found very useful in the low continuous fevers of the natives. An oil obtained by distillation from the leaves is likewise stated to be an effectual external application in rheumatism.

ANISOPLIA HORTICOLA, Curtis; *Phyllopertha horticola*, Kirby. The Small Chafer. This is a much smaller species of the same family (*Melolonthidæ*) as the cockchafer. Being so much smaller it escapes attention comparatively, yet it is very injurious to vegetation, and is especially troublesome in grass land and cultivated crops, working in the same manner as its larger congener. It feeds upon the leaves of forest trees and fruit trees, and upon the blossoms of apple and other fruit trees, in its perfect state; while in its larval state it attacks roots, tubers, and stems just below the ground. Köllar says that insects of a closely allied kind—*Anisoplia agricola* (1 and 2)—are found sometimes singly and sometimes three or four together, sitting on the ears and gnawing the still soft grains of rye or of wheat, which is still more to their tastes (' Naturgeschichte der schädlichen Inseckten,' von V. Köllar).

Life History. The perfect insect is dark coloured, with a tinge of metallic blue, or green, with yellowish or fawn-coloured elytra. The legs are black, also with a blue tinge. It has dark-coloured knobs at the ends of the antennæ, with only three leaves or folds. It may be seen in the spring upon limes, willows, beeches, and fruit trees, though not so high up in the trees as the May bug. Towards the end of August the beetles retire to the earth and lay eggs, from which larvæ soon come and attack the roots, remaining in the ground as long, and being transformed in the same manner as those of the larger cockchafer.

Prevention. The same modes of prevention should be observed as in the case of the cockchafers.

Remedies. Heavy rollings to make the land firm round the roots of corn plants, with or without dressings of artificial manure, should be tried. In grass land frequent rolling must be tried, and watering with liquid manure, or with gas liquor mixed with water in the proportion of one tenth of liquor to nine tenths of water. Watering with strong decoctions of quassia would be useful, and folding the land with sheep (' Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

ANI'SUM. Aniseed.

ANKLES, WEAK, in children. Very often the result of too early attempts to walk, in which case the remedy consists in rest and the discontinuance of the walking; rubbing with cold water in which a little bay-salt is dissolved is often useful. If the result of rickets, general treatment will be necessary and the advice of a medical man should be sought.

ANNEAL'ING. *Syn.* NEALING†§; LE RECUIT, Fr.; DAS ANLASSEN, Ger. The art of tempering by heat; appropriately, the process by which glass, porcelain, &c. are rendered less frangible, and metals which have become brittle by fusion, or long-continued hammering, again rendered tough and malleable.

Glass vessels, and other articles of glass, are annealed by being placed in an oven or apartment near the furnaces at which they are formed, called the ' leer,' where they are allowed to cool very slowly, the process being prolonged in proportion to their bulk.

Steel, iron, and other metals are annealed by heating them and allowing them to cool slowly on the hearth of the furnace, or in any other suitable place, unexposed to the cold. Steel is also annealed by being made red-hot, and in that state is placed in a heap of dry sawdust till cold, when it will be found quite soft.

Cast-iron is rendered tough and malleable, without ' puddling,' by embedding it in ground charcoal or hæmatite, and thus protected, keeping it exposed at a high temperature for several hours, after which the whole is allowed to cool very slowly.

Prince Rupert's drop may be mentioned as an example of unannealed glass, and common cast-iron of unannealed metals, to which heads the reader is referred.

ANNOT'TA. *Syn.* ANOT'TO, ANNAT'TO, ANNAT'TA; ARNAT'TO, ARNOT'TO, &c.; ORLEA'NA, TER'RA O.*, &c., L.; ROUCOL, ROCOU, ROUCOU, Fr.; ORLEANS, Ger. A colouring matter forming the outer pellicle of the seeds of the *Bix'a orella'na*, Linn., an exogenous evergreen tree, common in Cayenne and some other parts of tropical America, and now extensively cultivated in both the E. and W. Indies. It is usually obtained by macerating the crushed seeds or seed-pods in water for several weeks, ultimately allowing the pulp to subside, which is then boiled in coppers to a stiff paste, and dried in the shade. Sometimes a little oil is added in making it up into cakes or lumps. A better method is that proposed by Leblond, in which the crushed seeds are simply exhausted by washing them in water (—? alkalised), from which the colouring matter is then precipitated by means of vinegar or lemon-juice; the precipitate being subsequently collected, and either boiled up in the ordinary manner, or drained in bags and dried, as is practised with indigo. Annotta so prepared is said to be four times as valuable as made by the old process.

Prop. Good annotta is of a brilliant red colour; brighter in the middle than on the outside; feels soft and smooth to the touch; has a good consistence, and strongly characteristic but not a putrid smell. It is scarcely soluble in water; freely soluble in alcohol, ether, oils, and fats, to each of which it imparts a beautiful orange colour, and in alkaline solutions which darken it; acids precipitate it of an orange-red hue; strong sulphuric acid turns it blue. Its most important property is the affinity of its colouring matter for the fibres of silk, wool, and cotton.

Pur. Annotta is very frequently adulterated; indeed, nearly always so. To what extent the sophistication of annotta is carried may be judged from the statement of Mr Blyth, who says that on

examination of thirty-four samples of various kinds, as imported and obtained from English makers and as purchased from dealers, he found only two that were genuine. As annotta is often used to give colour to different articles of diet, it is important that it should be as pure as possible; otherwise injurious effects detrimental to health may be caused by partaking of any food to which it is added. Now, amongst the list of adulterants given below are three, at least, unmistakable poisons, viz. red-lead, orange chrome, and sulphate of copper. It is but right to state of the first of these substances (red-lead) that Mr. Blyth says it is extremely doubtful whether it is now employed to the extent it formerly was. He also ascribes its presence in annotta to the impure Venetian red which is used, the employment of this colour being a necessity because of the large quantities of flour and lime which are mixed with the annotta, which thereby becomes so reduced in colour that it is essential to have recourse to salt, alkalies, and the red earths to restore it to its original standard. The adulterants are generally meal, flour, or farina, and often chalk or gypsum, with some pearlash and oil, or even soap, to give it an unctuous character; turmeric, Venetian red, red ochre, orange chrome, or even red-lead, to give it 'colour;' and common salt, and sometimes even sulphate of copper, to prevent decomposition—the last two being poisonous. Sometimes a little carbonate of ammonia is also added to it to improve the colour. When quite pure it contains about 28% of resinous colouring matter and 20% of colouring extractive matter (*Dr John*), and should leave only a small quantity of insoluble residuum after digestion in alcohol, whilst the ash resulting from its incineration should not exceed 1½% to 2%. The quantity, colour, &c., of the ash will give an easy clue to the inorganic adulterants if any are present, which may be then followed up by a chemical examination. The presence of red-lead may be detected by heating it on a piece of charcoal in the reducing flame of the blowpipe, by which a small bead of metallic lead will be obtained. If it contains chalk, ochre, gypsum, &c., the undissolved residuum of the washed ash gives the amount of the adulteration (nearly).

Microscopical Examination of Annotta. When annotta is subjected to a microscopical examination the outer red portion will be found to present an almost homogeneous appearance, whilst the surface of the seed proper will be seen to consist of narrow or elongated cells or fibres disposed in a vertical direction, while the inner white portion will be seen to be made up of cells filled with starch corpuscles, well defined, of medium size, and resembling in the elongated and stellate hilum the starch granules of the pea and bean.

When the annotta is manufactured, and an unadulterated sample is examined, but little structure is met with. Portions of the outer cells may be seen; and in those samples which, in the course of their preparation, have not been subjected to the action of boiling water a few starch granules may be observed.

Since annotta, when manufactured, presents so few evidences of structure, we are easily able, with the microscope at our command, to detect the presence of most foreign vegetable substances. These consist of turmeric powder, wheat, rye and barley starch, and sago flours. The salt and alkali present in the fraudulent annotta generally greatly alter the appearance of the turmeric. Most of the colouring matter of the cells is discharged, so that the starch corpuscles contained within them become visible. Loose starch granules of turmeric may also be frequently seen, and in a much enlarged condition, owing to the action of the alkali upon them.

The following process for conducting the assay of annotta is given by Mr Blyth:

"In order to estimate the commercial value and detect adulteration in a sample, the quickest and best way is the following: Weigh accurately a gramme in a small platinum dish; dry in the water-bath for a couple of hours, then weigh: the loss is the water. Finely powder, and digest it for some hours in alcohol; then boil, filter, and treat with successive portions of alcohol until all the colouring matter is dissolved; filter, evaporate the filtrate down and weigh: the result is the resin. The insoluble portion will in a good commercial specimen consist of woody matter, extractive, gluten, &c. For the ash weigh another gramme in a platinum dish; dry for a short time over the water-bath; then powder and burn until it ceases to lose weight. It is prudent to fuse a little on charcoal with carbonate of soda before the blowpipe before burning it in a platinum vessel, as there may be lead in the annotta. The ash should then be submitted to the various reagents in order to detect lime, alumina, &c. A correct determination of ash and resin is all that is required to definitely pronounce upon the purity or impurity of the samples."

The following is the analysis of a fair commercial sample:

The sample was in the form of a paste, colour deep red, odour peculiar but not disagreeable.

Water	24·2
Resinous colouring matter .	28·8
Ash	22·5
Starch and extractive matter	24·5
	100·0

The following is an analysis of an adulterated specimen:

The sample was in a hard cake of a brown colour, with the maker's name stamped upon it, and marked 'patent;' texture hard and leathery, odour disagreeable.

Water	13·4
Resin	11·0
Ash, consisting of iron, chalk, salt, alumina, silica . . .	48·3
Extractive matter	27·3
	100·0

Thus in the one the reisn was 28%, the ash 22%; in the other the resin was only 11%, the ash no less than 48%.

Uses, &c. To colour varnishes and lacquers; as a pigment for painting velvet and transparencies; as a colouring matter for cheese (1 *oz.* to 1 *cwt.* of curd), for which purpose it is not injurious if pure; and as a dye-stuff for cotton, silk, and wool, particularly the second, to which

it imparts a beautiful orange-yellow hue, the shade of which may be varied from 'aurora' to deep orange by using different proportions of pearlash with the water it is dissolved in, and by applying different mordants before putting it into the dye-bath, or different rinsing liquids afterwards. The hues thus imparted are, however, all more or less fugitive.

Annotta Cake. *Syn.* FLAG ANNOTTA; ORLEA'NA IN FO'LIIS, L. From Cayenne; bright yellow, firm and soft to the touch; in square cakes, weighing 2 or 3 *lbs.* each.

Annotta Egg. *Syn.* LUMP ANNOTTA; ORLEA'NA IN O'VULIS, L. Generally inferior.

Annotta, Eng'lish. *Syn.* TRADE A., REDUCED' A.; ORLEA'NA REDUC'TA, L. A fraudulent mess commonly prepared from egg or flag annotta, gum tragacanth, flour, or farina, chalk, soap, train oil, Venetian red, or bole, common salt, water, mixed by heat in a copper pan, and formed into rolls. Sold for genuine annotta, from which it is readily distinguished by its inferior quality and its partial solubility in alcohol.

Annotta, Liq'uid. See SOLUTION OF ANNOTTA (*below*).

Annotta, Pu''rified. See ORELLINE.

Annotta Roll. *Syn.* ORLEA'NA IN ROT'ULIS, O. IN BAC'ULIS, L. From the Brazils; hard, dry, brown outside, yellow within. When pure this is the variety most esteemed, and the one preferred for colouring cheese.

Annotta, Solu'tion of. *Syn.* ESSENCE OF ANNOTTA, EXTRACT OF A., ANNOTTA DYE, &c.; SOLU'TIO ORLEA'NÆ, EXTRAC'TUM O., &c., L. A strong aqueous solution of equal parts of annotta and pearlash, the whole being heated or boiled together until the ingredients are dissolved. Sold in bottles. See ANNOTTA (*above*), NANKEEN DYE, &c.

ANNUALS. Plants which bear flowers and fruit in the same year, when raised from seed.

AN'O-. [Gr.] In *composition,* upwards, &c.; as in anocathar'tic (emetic).

AN'ODE. Literally, 'upward way;' in *electro-chemistry,* the 'way in,' or that by which the electric current is supposed to enter substances through which it passes, as opposed to the CATHODE, or that by which it goes out; the positive pole of a voltaic battery.

ANODONTA CYGNEA. The fresh-water mussel, a bivalve mollusc which lives in fresh-water streams, with its anterior end buried somewhat obliquely in the mud at the bottom, and the posterior end projecting up into the water. By means of a muscular foot it can plough its way slowly along the bed of the stream. Its food consists of minute organisms, both animal and vegetable, which are swept in at the under end of the shell by ciliary currents, and carried forwards to the mouth, the stream of water so kept up serving for respiration as well as nutrition. The sexes are distinct. The young embryos are retained within the mother during the early stages of development; they then hatch and attach themselves to fish. While so attached they increase considerably in size, and undergo a distinct metamorphosis. Finally they detach themselves, and adopt the mode of life of the adult.

ANODYN (*Müller,* Berlin). Chiefly for rheumatic pains, toothache, &c. Oil of rosemary, 30 drops; oil of thyme, 10 drops; camphor, 5 grms.; spirit of ammonia, 12 grms.; spirit, 60 grms. (*Hager*).

AN'ODYNE (-dīne) [A, priv., and ODUNE, pain, Gr.]. *Syn.* ANO'DYNUS (-dĭnŭs), L.; ANODIN, Fr.; SCHMERZSTILLEND, Ger. That allays pain; soothing; atalgic.

Anodynes. *Syn.* ANO'DYNA (sing., ano'dynum), L.; Anodins, REMÈDES A., Fr. In *medicine* and *pharmacy,* substances and agents which relieve pain by lessening the excitability of nerves or of nerve-centres. Some (as the PAREGORICS) act by actually assuaging pain; others (HYPNOTICS) by inducing sleep; whilst a third class (NARCOTICS) give ease by stupefying the senses, or by lessening the susceptibility to pain. Anodyne medicines include opium and its alkaloids—morphine and codeine, bromide of potassium, cannabis indica, belladonna and its alkaloid—atropine, hyoscyamus and hyoscyamin, stramonium, aconite and aconitine, veratrum and veratrine, conium and conine, lupulus and lupulin, gelseminum, chloroform, ether, and their allies, chloral hydrate, butyl-chloral hydrate, and camphor; to which must be added spirituous liquors, wines, and the stronger varieties of malt liquor. The frequent use of anodynes begets the necessity of their continuance.

Anodyne Colloid. Take of hydride of amyl, 1 oz.; aconitia, 1 gr.; veratria, 6 gr.; collodion, to 2 oz. Dr M. H. Lackerstein recommends the above as an anodyne application in cases of neuralgia, sciatica, lumbago, and muscular pains.

Anodyne, In'fantile (-īle). *Syn.* ANO'DYNUM INFAN'TILE (-tĭl-e), L. *Prep.* Take of syrup of poppies, 1 *oz.*; aniseed water, 3 *oz.*; French brandy, $\frac{3}{4}$ *oz.* (or rectified spirit, $\frac{1}{2}$ *oz.*); calcined magnesia, $\frac{1}{4}$ *oz.*; mix. An excellent anodyne and antacid for infants.—*Dose.* A small teaspoonful as required.

ANODYN'IA (dĭn'-y'ă). Freedom from pain.

ANOGEISSUS LATIFOLIA, Wall. A large tree, common from the Himalaya to Ceylon. The gum yielded by this tree is extensively used in cloth printing in India, and the leaves in tanning.

ANONA MURICATA. The fruit known in the West Indies as the Sour Sop is considered to be of a cooling and agreeable nature, and is said to have cured intermittents when taken on an empty stomach. A decoction of the root is given in Guadeloupe as a cure for fish-poisoning. The Indians believe that the root is a cure for epilepsy when taken internally in the form of a decoction. The leaves are commonly thrown into fowl-houses for the purpose of destroying fowl lice. A wine is made from the unripe fruits, which is considered good for diarrhœa and for canker of the mouth in children. The leaves applied to a boil are said to ripen it and cause it to burst (*Christy*).

AN'OREXY. *Syn.* ANOREX'IA, L.; ANOREXIE, Fr., Ger. In *pathology,* want of, or morbidly diminished appetite, without loathing of food. It is usually symptomatic of other affections. See APPETITE, DYSPEPSIA, &c.

ANOSMIN FOOT POWDER (*Dr Oscar Bernar,* Vienna). "An unfailing remedy for sweaty feet and bad odour of the feet." Powered alum, 21 parts; maize meal, 1 part (*Hager*).

ANOSMIN FOOT WATER (*Koch*), for a

similar purpose. An aqueous solution of tartaric acid.

ANOZABAGLIONE (-băl-y'ō'-nā.). *Prep.* Put 2 eggs, 3 teaspoonfuls of sugar, and 2 small glassfuls of sherry or marsala into a chocolate cup, placed in boiling water or over the fire, and keep the mixture rapidly stirred until it begins to rise and thicken a little; then add 1 or 2 teaspoonfuls of orange-flower water or rose water, and serve it up in wine-glasses. A pleasant Italian domestic remedy for a cold.

ANT (ănt). *Syn.* EMM'ET, PIS'MIRE*‡ (pĭz'-); FORMI'CA, L.; FOURMI, Fr.; AMEISE, Ger.; ÆMET, Sax. This well-known little insect belongs to the family Formi''cidæ, and the Order HYMENOP'TERA. Like the bee, it is a social animal, lives in communities which may be compared to well-regulated republics, and is of three sexes—male, female, neuter. Those belonging to the last alone labour and take care of the ova and young. The red ant contains FORMIC ACID (acid of ants), and a peculiar RESINOUS OIL. Both of these may be obtained by maceration in rectified spirit. A tincture so prepared, and flavoured with aromatics, constitutes Hoffman's EAU DE MAGNANIMITÉ, once greatly esteemed as an aphrodisiac. See FORMICA, FORMIC ACID, FORMYLE, &c.

Ants, White. *Syn.* TERMITES. There are several species of white ant indigenous to Africa, America, and tropical Asia, where they are perhaps the greatest of all insect pests, inasmuch as their enormous numbers and infinite capacity for destruction make it very difficult to provide against their ravages. Not only will they consume articles of food and clothing, but are especially destructive to the woodwork of houses, often devouring the whole interior of a beam and leaving a mere shell. Creosoted timber is not so much affected by them, but it is better to use for building only those species of timber which they cannot or will not attack, such as teak. In places much infested by them it is often necessary to place the legs of chairs and tables, &c., in large trays of water. If the trays are kept full of water and all other means of access cut off the plan is fairly successful, but it involves no small amount of care and trouble to maintain the water supply. Articles of clothing, woollen and leather goods, paper, books, &c., may be destroyed in a few hours by an invasion of these insects, and it is accordingly necessary to store them in tin cases, and adopt every possible means for preventing the access of the ant. They are said to avoid books bound in russia leather, but this will probably not avail much against numbers.

The rate of propagation of the white ant is almost incredible; the bulk of the female when fully distended with eggs (which she lays at the rate of 60 a minute, or 86,400 per diem) is said to be equal to that of 20,000 or 30,000 workers. The white ant of Africa builds conical hillocks 8 to 10 feet in height, and very solid and compact. According to various authors there are at least 24 species of these insects—9 in Africa, 9 in America, 2 in Asia, and 2 in Europe. Their habits and the structure of their dwellings are exceedingly interesting, especially those of the fighting species, *Termes bellicosus*. They are not really ants at all, but only resemble them in form and habits. They belong to the Nat. Ord. NEUROPTERA.

In Africa white ants are esteemed a great delicacy as food. They are collected at the swarming season, when they are about half an inch long and resemble grains of rice. The usual way of catching them is to break into the mound, and wait till the workers come out to repair the damage; they are then brushed off into a shovel.

Ant-Lion. *Myrmeleon formicarum.* A neuropterous insect, in its perfect state somewhat resembling a small dragon-fly. In the larva state the ant-lion digs conical holes in the sand, and lies in wait at the bottom for insects which may fall in, especially ants; hence its name. The holes are about 2 in. deep and 3 in. in diameter at the top. The insect removes the sand from the centre of the pit by carrying it on its head, which it loads with its fore-legs, using them as shovels. The larva state lasts about two years; it then forms a cocoon of sand, lined with a sort of silk, about half an inch in diameter. In about three weeks the perfect insect emerges, and when expanded is an inch and a quarter long and nearly three inches across the wings.

ANTAC'ID (-tăs'-ĭd). *Syn.* ANTAC'IDUS, L.; ANTACIDE, &c., Fr.; SÄURETILGEND, &c., Ger. An agent which neutralises acids or removes acidity. (See *below.*)

ANTAC'IDS (tăs'-ĭdz). *Syn.* ANTAC'IDA, L.; ANTACIDES, &c., Fr. Medicines used to counteract the acidity of the secretions. The antacids include potash, soda, lithia, ammonia, lime, magnesia, and their carbonates, as well as the salts which these alkalies form with the vegetable acids, such as citrates, acetates, and tartrates,

Antacids are divided into two groups: those which act directly, lessening the acidity of the stomach; and those which act remotely, diminishing the acidity of the urine. The alkalies, alkaline earths, and their carbonates act in both ways, with the exception of ammonia and its carbonate, which act directly. Acetates, citrates, and tartrates of the alkalies and alkaline earths act remotely, being converted into carbonates in the blood and excreted by the urine, thus diminishing its acidity.

Uses. Excessive acidity of the stomach may arise from either the secretion of too acid juice or from the decomposition of the food when digestion is too slow and imperfect. Antacids given after meals afford immediate relief to the symptoms, but are often even more efficacious before by preventing it. If the action of the bowels be regular soda is preferable; but lime should be used if they are relaxed, and magnesia if there is a tendency to constipation.

Remote antacids are useful in diminishing the acidity of the urine in certain diseases of the urinary organs, and to prevent the deposition of uric acid and gravel or calculus in gouty persons.

ANTAGONISM OF DRUGS. Physiological experiment has shown that certain drugs possess the property of antagonising the effects of certain other drugs; that is to say, of producing the contrary result. The best examples of this are physostigmine and atropine, atropine and prussic acid, atropine and muscarin, chloral and strychnine. Unfortunately this physiological antagonism

exists only within very narrow limits, and the hopes that it might prove useful as the basis of a method of treatment in cases of poisoning by these drugs have only been realised in a very limited degree.

ANTAL′GICS (-tăl′). *Syn.* Antal′gica, L. Medicines which relieve pain; anodynes.

ANTAL′KALINES (ănt-ăl′-kă-līnz). *Syn.* Antalkali′na, L. Agents or medicines which correct alkalinity. All the acids except the carbonic are antalkaline.

AN′TE-. In *composition,* before, contrary, opposite; generally in the first sense. See Anti-.

ANTHELMINTICS. [Gr. *anti,* against; and *elmis,* a worm.] Medicines which kill or expel worms from the intestines.

The principal anthelmintics are: Oil of male fern, kamala, kousso, oil of turpentine, pomegranate root bark, worm-seed and its active principle santonin, areca nut, mucuna, rue, and drastic purgatives. As purgatives only expel the worms, they are called vermifuges; whilst the other anthelmintics which kill the worms are called vermicides. See Worms.

ANTHEMIS NOBILIS. See Chamomile.

ANTHOK′YAN. *Syn.* Succ′us vi′olæ præpara′tus, L. The expressed juice of the sweet or purple violet (*Vi′ola odora′ta,* Linn.), defecated, gently heated in glass or earthenware to 192° F., then skimmed, cooled, and filtered; a little rectified spirit is next added, and the following day the whole is again filtered. It must be kept well corked, and in a cool situation.

Uses, &c. Chiefly to make syrup of violets, to colour and flavour liqueurs, and as a chemical test. The London druggists obtain it principally from Lincolnshire.

ANTHOMYIA BETÆ (*Curtis*). [From ἄνθος, a flower; and μυῖα, a fly.] The mangel-wurzel fly. The attack of this *Anthomyia* upon mangel-wurzel plants appears to be of comparatively recent date. It was hardly known to farmers until 1876, though Curtis describes it in 'Farm Insects' in 1859, and states that specimens of its maggots were shown him as taken from leaves of a mangel-wurzel plant in Surrey.

In 1878 a good deal of mischief was caused by this insect in various parts of England. In 1879 the mischief was intensified, and extended to Scotland and Ireland; and in 1880 it was worse, so that in some districts serious losses were sustained by cultivators of mangel-wurzel, which has become such an important crop to stock and sheep breeders. During the last six seasons it has been more or less troublesome. In some cases the leaves of mangel plants have been attacked so early and so extensively, that the crop was reduced almost to nothing. As an instance of this, it may be stated that a large field in Kent was sown with mangels, and the plants were well established and fit for singling early in June. Directly after this operation they showed symptoms of flagging, proved to be due to the presence of maggots in the leaves. Maggots were found in quantities, and the leaves were much blistered, and had a whitish, unnatural look. plainly seen at some distance. Many of the plants came to nothing. A few developed roots, misshapen and stunted. It would have paid better to plough up the whole, and put in late swedes.

In several parts of the country it was noticed that the large leaves of mangels with fair-sized roots were much scarred by the action of the maggots, which were evidently affecting materially the progress of the plants. These had struggled on as long as they could, assisted by the good manuring they had received, but were getting the worst of the struggle. The attack had not been commenced until the beginning of July, and this of course gave the plants some advantage. Where the maggots appeared at the time of singling, and remained and multiplied, there was but a poor prospect of a crop. In a small field in Sussex the appearance of the mangel plants upon it in July was most remarkable. They seemed as if they were covered with hoar-frost, which glistened in the sunshine. A labourer remarked that they looked as if they had been 'fireblasted.' A Hampshire farmer estimated his losses from the *Anthomyia betæ* in 1881 at £100; and another in Derbyshire wrote that he considered he was quite 120 tons of mangel short, which according to his estimate was equal to a loss of at least £100. A landowner, farming his own land in Essex, reported that the worst attack he ever had was in 1879, the memorable wet season, when the maggots were discovered first on the 6th of June upon the very young plants. He ploughed up six acres, and would have done better if he had treated 15 acres more in a similar manner, for their total yield was only about 40 tons of small badly-shaped roots.

Kaltenberg says that this insect is known in Germany as living in the leaves of mangel-wurzel. Nördlinger speaks of a species of *Anthomyia* attacking beet plants in Germany, which resembles *Anthomyia conformis,* Fallen ('Die Kleinen Feinde der Landwirthschaft,' von Dr H. Nördlinger, page 556). Linter relates that an *Anthomyia,* almost exactly similar to the English species, is found in beet leaves in America. It is well known in France as destructive to beet plants.

Life History. The *Anthomyia betæ* is a species of the genus *Anthomyia,* of the large family *Muscidæ.*

The fly is about the size of a house-fly, nearly the fourth of an inch long, and a little more than half an inch across the wings. Its main colour is dark grey; the thighs, or femoræ, and the last joints of the legs are black. The shanks, or tibiæ, are shiny black; while the feelers, or palpi, are yellow.

It appears very early in the spring, and places eggs upon the under sides of the leaves of mangel plants. These eggs are white, and almost cylindrical in shape, with delicate reticulations or network upon them. They are placed in groups of two, three, and four.

Though very tiny, they can easily be seen with the naked eye, standing on their ends upon the under sides of the leaves. As many as forty eggs have been seen upon a single leaf. In a few days the maggot creeps forth from the egg, and bores at once into the cuticle, making its way into the soft tissues of the leaf upon which it lives, moving on as the food near it gets exhausted. It is by no

means unusual to find two or more maggots in one burrow. It is yellowish, or what may be described as dirty yellow, without legs, about four lines long, with the fore-part of the body pointed, and the hinder part thick. The segments are not clearly defined. Its jaws are extended so as to form an admirable instrument for cutting the leaf tissues, not unlike a pair of sugar-cutters.

Pupation takes place in a month or six weeks. Some of the maggots fall to the ground, and are transformed under its surface, while the transformation of others is accomplished within the mines or burrows made by the maggots in the leaves. Miss Ormerod holds that "they pupate more commonly in the ground" ('A Manual of Injurious Insects'), and this is the experience of other observers who have noted that the maggots suddenly disappear from the leaves.

There are at least two broods, or generations, during the summer. In some cases there are three, or even more broods when the conditions of weather are entirely favourable. The flies come forth from the pupæ of the summer broods in about twelve days. The pupæ of the last broods pass the winter in the ground, as well as in decaying leaves and manure. Mixens of farmyard manure, that is to say, old mixens, as well as compost heaps which have lain for some time, are favourable places for the pupæ of this species of *Anthomyia.* Westwood says that this "species of the genus *Anthomyia* and the allied genera undergo their transformations in rotten vegetable matter, or in manure, excrement, &c." ('An Introduction to the Modern Classification of Insects'). The *Anthomyia betæ* deposits its eggs upon plants of the *Cynaroidæ* and *Cichoriaciæ,* as some of the thistles (*Carduus*), sow-thistles (*Sonchus*), and dandelion (*Taraxacum*), and others, as well as upon the mangel-wurzel and beet plants. These weeds are always to be found upon old mixens and compost heaps, which thus serve as breeding-places of the *Anthomyia betæ.*

Prevention. All the leaves of mangel-wurzel plants in fields that have been infested should be very carefully collected after 'topping and tailing,' and burnt, or put into actively heating mixens. They must in no circumstances be left in lumps on the outsides of fields, or be thrown upon mixens and compost heaps, or taken into yards. Many cultivators of this plant strip the greater part of the leaves during the summer, and carry them into yards and pastures for cattle, thinking that the roots become larger if deprived of the sources of food supply from the air. Leaves of plants attacked by the *Anthomyia* should on no account be carried into pastures. If they are taken into yards care must be taken that all pieces not consumed should be subjected to mixen heat.

In the ordinary course of farming the land is ploughed directly after the crop is taken off, so that it may be concluded that the pupæ just under the surface would be deeply buried. As a rule, wheat is put in after mangel-wurzel. But it is not unlikely that the land might be allowed to remain uncropped during the winter, especially if it be stiff land, and ploughed again before it is cropped in the spring. This would be a fatal action after a bad attack, as the pupæ would be turned up to the light and air, and, being transformed, would fly to the nearest mangel-wurzel plants, or to the nearest composite plants of their affections, and perpetuate their species.

Not only is this insect bred and reared upon old mixens and compost heaps, and flies from these to fields of mangel-wurzel, but it may very possibly be conveyed in pupal guise to where mangel-wurzel is to be planted, with the manure, and though this is ploughed in, some of it may be torn up by the horse hoes, and the fly allowed thereby to be evolved.

Mixens should be kept turned so that no weeds may grow upon them, and farms and their outsides kept free from weeds as far as possible.

Remedies. Applications of lime or soot or guano are not very efficacious, because the larvæ are under the leaves. Washing the plants with quassia and soft soap by means of large garden engines, as used for hop washing, with long flexible hose, which can be directed under and all over the plants, has been adopted with success. (The ordinary hop-washing engine, costing about £7 10*s.*, would be available until the plants got too high, as it could be taken over a drill of plants. If it were necessary to wash plants when high, a long, narrow engine might be easily contrived to go between the drills). It should be done directly there is any sign of an attack. Paraffin or petroleum washes are also useful, but it is necessary that there be soft soap with either of these oils, to fix the wash upon the leaves. A composition is made by American agriculturists, recommended by practical entomologists, of 2 galls. of petroleum or paraffin oil to 1 gall. of boiling or hot water in which ¼ lb. of soft soap has been dissolved. This requires to be well stirred together for some time, and diluted with at least nine times its bulk of water. A more suitable wash would be from 6 lbs. to 7 lbs. of soft soap, and 1½ galls. or 1 gall. of paraffin or petroleum oil, to 100 galls. of water. But there can be nothing better than a mixture of 5 lbs. to 6 lbs. of soft soap, 5 lbs. to 6 lbs. of quassia, with 100 galls. of water.

Stimulating manures should be applied to mangel-wurzel plants attacked by this fly. Nitrate of soda put on at the rate of 1½ cwt. per acre is very efficacious. A farmer in Kent, whose plants were infested, dressed them on the 20th of June with 1 cwt. of nitrate of soda, and again on the 20th of July with another cwt. This dressing forced a strong growth of leaves, and, as he believed, saved his crop.

ANTHOMYIA CEPARUM, *Bouché* [*cepa,* or *cepæ,* an onion]. The onion fly. It might be considered that the strong flavour of onions would effectually safeguard them against the onslaughts of insects. But even onions are not exempt from the evils to which all vegetation appears liable, and they have their special enemy in the shape of a little maggot, born of a small fly, which penetrates into the very hearts of their bulbs and feeds upon their vital parts, at the same time making them rotten and unfit for storing.

Onions are important vegetables to every cottager, imparting an appetising flavour to his most humble fare, and no garden is without them. They are also cultivated to a very large extent by acres in the market gardens and market-garden farms in various districts of the United Kingdom,

and are most profitable in some seasons ('The Report upon the Market Garden and Market Garden Farm Competition, in connection with the Royal Agricultural Society's Show at Kilburn in 1879,' by Charles Whitehead, F.L.S., F.G.S.). Onions are very largely grown in Bedfordshire, whose soil suits them particularly well, and in Lancashire, as well as in many other places. Curtis speaks of this fly in his 'Farm Insects,' and Professor Westwood has described it in the 'Gardeners' Magazine;' but since these dates the injuries caused by it have become greatly intensified, and since 1875 there have been many outcries concerning it from all parts of the country.

The first indications of the attack are the flagging and yellowness of the leaves, and evident unhealthiness of the whole plant. Mildew often appears, caused by the fungus *Peronospora Schleideniana,* which, like many other fungi, fastens upon plants that are unable to resist its attack or to grow away from it. Upon endeavouring to pull up a bulb the leaves come off easily in the hand, at least when the injury is in an advanced stage. The bulbs in many cases show signs of decay, and small maggots will be found within them. Sometimes the inside of the bulb has been almost entirely eaten away by the maggots. Sometimes it is a mass of rotten matter. It frequently happens that bulbs which are stored, not having much outward indication of being infested, decay rapidly in the store-rooms from previous injuries.

The *Anthomyia ceparum* is known in Germany. Köllar says that it does great damage among the white onions, so that it often destroys the whole crop ('Naturgeschichte der schädlichen Insekten,' 1837). Kaltenbach relates that he saw whole fields of onions devastated by this insect. In France it is equally destructive. Professor Lintner reports that it is very troublesome to onion plants in the United States, and that it was introduced from Europe ('Report on the Injurious Insects of the State of New York,' 1882), as so many injurious insects have been, with fruits, grasses, cereals, and garden vegetables, nearly all of which are of foreign importation.

Life History. The onion fly is of the Order DIPTERA, the family *Muscidæ,* and the genus *Anthomyia.*

It has been found that there are at least two species of this genus *Anthomyia* which attack onions, both in this country and in Germany and America, viz. this, the *Anthomyia ceparum,* and another very similar, known as *Anthomyia platura.* This was identified by Mr Meade, to whom specimens of larvæ taken from onion bulbs were sent by Miss Ormerod and Professor Lintner. It is not deemed necessary to describe this latter fly, as it is in essentials so like *Anthomyia ceparum,* as well as in its habits and modes of attack. It has been suggested that there are differences in the methods of egg-laying, and that the *Anthomyia ceparum* places its eggs upon the leaves of the bulbs, while the *Anthomyia platura* puts them upon the junction between the leaves and the bulb close to the ground, and upon the bulbs when formed. This has not been verified in any way. Curtis is the only authority for the statement that the eggs of an onion fly are deposited upon the leaves. All other writers state that the eggs of onion flies are put on the plant close to the ground.

The fly is the fourth of an inch long. Its wing expanse is three fourths of an inch. The female is of a grey colour or reddish grey, with whitish face and pale grey wings. The male insect is rather darker than the female. The eggs, white and oval, are first laid towards the end of April. Each female lays a considerable number, but does not put more than five or six upon a plant. At this time, the onion plants being small and not yet bulbed, the eggs are placed in the sheath of the leaf on the neck of the bulb, close to the ground. Afterwards, when the bulb is formed, they are placed directly upon it. In the course of six or seven days larvæ or maggots or hatched, and burrow down into the stem, or into the bulb if formed. In the early stages of the plant one larva is sufficient to irretrievably damage it. As many as eight maggots have been found in bulbs of some size which they had utterly ruined.

The larva or maggot is about four lines, the third of an inch, in length. It is somewhat curved in shape, the upper part of the body terminating in a sharp point. The mouth is furnished with a pair of hooks for cutting the food. The lower end of its body is squared off, and has eight projecting points upon it. It is of a dull white colour, and has no legs. In 14 days the larva begins to change, and is shortly covered with a chestnut-coloured skin or puparium. From this the fly emerges in about a fortnight in the case of the summer broods.

Pupation takes place both in the ground and in the bulbs. The puparia are frequently seen within these. The winter is passed in the puparium in the ground, as well as in stored bulbs.

Prevention. Where onions are sown in rows or drills—and they should always be sown in this manner when there is any fear of the attack of this insect—they should be earthed up slightly as soon as the plants are established. This may be done with a light hoe. By this means the flies are prevented from placing eggs upon that part of the plant which they instinctively select. Miss Ormerod says, with regard to this earthing up, "In personal experiment I find that any measures which will preserve the bulb from being exposed above ground, or which will bury it again up to the neck if exposed in hoeing, are very serviceable" ('Report on Observations of Injurious Insects' for 1883).

Where onions are extensively grown, if the horse hoe is used the earth is often moved away from the plants. Earthing should follow this operation. This may be done by a very light mould plough, or boards nailed together in a V shape, if the drills are evenly set, after the plants have attained a considerable size.

As the pupæ, or many of them, are in the ground after an attack, it is desirable to plough up the land deeply and give it a good dressing of lime. Onions should not be grown the next season near infested fields.

Remedies. Soot, or guano finely powdered, has been efficacious in checking this insect, especially

if heavy showers have followed the application. Washing the plants is a useful remedy, either with paraffin and water in the proportion of 4 pints to 25 galls. of water, or with an infusion of 12 lbs. of quassia in 100 galls. of water, and 3 lbs. of soft soap. This may be done with garden engines with hose, having rose, spray, or plain jets directed into the ground close around the plants. (The ordinary hop-washing engine will go easily down over the drills of these plants.)

Up to a certain point it might be useful to pull up and take away plants that are seen to be infested by their sickly appearance. Upon large breadths of onions this would probably be almost impracticable ('Reports on Insects Injurious to Crops, by Charles Whitehead, Esq., F.Z.S.).

ANTHONOMUS POMORUM (*Curtis*), from two Greek words, signifying living in flowers. *Curculio pomorum*, Linn. The Apple Blossom Weevil. The serious destruction to the apple crop in certain seasons by this tiny weevil is hardly realised; or at least is generally attributed to other causes, as the weather, for instance, and moths and saw-flies. In seasons in which the development and growth of the apple blossoms are retarded by cold nights and white frost this insect has great opportunities, and does not fail to avail itself of them. On the other hand, when the blossoms come out quickly, and fructification and the formation of the apples follow on without let or hindrance, much of the risk is diminished because it takes some time for the eggs of the weevil to hatch after being placed upon the buds, and the most important harm is occasioned in the early stages of the blossoms. Also when the petals expand the larvæ of the weevils are deprived of necessary shelter from sunshine, wet, cold, and possible white frosts, and are unable to pursue their evil courses.

Upon apple trees infested with the *Anthonomus* it will be noticed that some of the blossoms are fully expanded with the petals lying flat and preparing to drop, with the young fruit already showing. Others have the petals still erect, and preserving in a degree their original balloon shape. At the same time it will be observed that the blossoms have a slightly withered appearance, and upon pulling away their petals a white maggot will be found buried in the stamens, whose tops it has already devoured. Later on the petals become shrivelled up and collapse entirely, showing that the pistils, stamens, and style have all been cleared out, and the circular base of the calyx left clean and bare by the maggot, which, however, has vanished.

As many as 40% of the apple blossoms have been completely destroyed in this way by the *Anthonomus* in years favourable to its work. It may be found every spring-time in every orchard and garden more or less abundantly. No sorts of apple trees seem to be spared. Early sorts and late sorts are both equally liable to be attacked, as there is a steady succession of egg-laying weevils from the time when the June eatings, Gladstones, and Keswick Codlings begin to bloom to the date when the Russets, Nonpareils, and other late kinds are in full wealth of blossom.

Now and then, and especially when the apple blossoms hang a long while, the crop in the apple orchards of Devonshire, Somersetshire, Herefordshire, and Worcestershire is materially reduced by the operations of the apple blossom weevil.

To show the difficulties in the way of apple blossoms coming to perfect maturity, it may be stated that in one cluster of four blossoms upon a Blenheim Orange apple tree, in a sheltered well-managed grass orchard facing south, no less than four different and destructive insects were found. Within one were the caterpillars of the Winter Moth. In another were the web-surrounded larvæ of the Ermine Moth. Deep in the stamens of a third revelled the curled-up maggot of the Apple Weevil, while the fourth showed that the Ermine Moth and the *Anthonomus* had arranged a 'happy family.' This was on the 15th May, and it was clear from the condition of the rust-tinged blossom that the maggots of the *Anthonomus* would soon put on the chrysalis state. On the 18th of May pupæ were formed among the *débris* of the flowers enshrouded in the decaying petals (1886).

French fruit growers suffer many things from the apple weevil. They also complain that, though this insect preys upon pear trees when it cannot find apple trees, there is another species which is only seen upon pear trees. M. Rendu confirms this, remarking that another *Anthonomus* than that of the apple tree is frequently found in the environs of Paris, also in the south-west of France, but is not so common there as near Paris ('Les Insectes nuisibles à l'Agriculture,' par V. Rendu, Inspecteur-Général [honoraire] de l'Agriculture. Paris, 1876).

Life History. Belonging to the Order COLEOPTERA, an order abounding with strange insects of all sizes, shapes, and extraordinary habits, the *Anthonomus pomorum* is placed in the numerous family *Curculionidæ*. Although the author of a large amount of harm and entailing much loss upon cultivators, it is very small, as so many of the worst pests are, measuring only about two lines or the sixth of an inch in length, including its abnormally prolonged snout or rostrum. It is brown in colour, and may be identified at once by a peculiar V-shaped mark upon the middle of its elytra or wing-cases. The six legs are rusty red, with a dark band around each of them. From the black head of the weevil proceeds a long rostrum, somewhat curved and rather wider at the extremity, spatulate or spoon-shaped. Immediately at the base of this are the eyes; and about halfway up the rostrum are the very peculiar antennæ with elbows or joints, and whose tips, as seen under the microscope, have pronounced club-shaped ends.

As soon as the sun begins to have power, forth come the weevils in shoals from their winter hiding-places under the bark of the apple trees, or under the clods and stones and rubbish near them, and proceed to pair. When the weather is calm and warm the females fly and crawl to the still undeveloped apple blossoms, in which, after a very careful scrutiny as to what may be a proper receptacle for their eggs, they bore holes in the lower part of the developing calyces. Into each of these holes a single egg is placed, being pushed

as far as possible into the heart of the bud in the midst of the group of pistils and stamens, by means of the rostrum. During this operation the long flexible antennæ play an important part, serving as guides and measures of distances. Some entomologists aver that the hole is fastened up again by the weevil in some way. This has not been personally confirmed. At the same time it must be said that there is no visible aperture, and it is quite possible that the little orifice may have been closed by the weevil, or by the natural reintegration of the succulent substance.

Each female lays many eggs, but only one in each bud. In about seven days the eggs are hatched, and the larvæ or maggots begin at once to devour all around them. The larva is at first quite white, then it assumes a creamy coloured hue as it gets towards maturity or the end of its larval state, which is between eleven and fourteen days, depending upon the weather and the food, being nearly two lines long. It lies curled up in the form of a bow, and has no feet, moving itself slowly by means of pointed tubercles upon the fourth and eighth following segments of its body, as Westwood shows in his 'Introduction to the Modern Classification of Insects.'

The pupa is merely, as in the case of beetles and weevils generally, an inanimate shadowy representation of the coming imago, and the transformation is consummated in six or seven days. Having remained quiet for a few hours the regenerated weevil betakes itself to the foliage of the apple trees, and feeds thereupon until the autumn, when it retires to crannies in the bark or to safe retreats under the surface of the ground, or stones, or clods.

Prevention. Most difficult it is to devise effectual methods of checking and preventing these very tiny creatures, endued as they are with double means of locomotion, and taking up their quarters in the hearts of the buds, from which they cannot be dislodged. After a bad attack the bodies and limbs of the apple trees for some distance beyond the forks should be well scraped and washed over with a mixture of lime wash and paraffin oil, in the proportion of a pint of oil to one gallon of wash, well stirred together, and well brushed in. A little soft soap, or size, might be added to make the composition adhere to the bark. Carbolic acid may be used for paraffin in the proportion of a pint to five gallons of wash. A capital mixture of soft soap and petroleum has been made lately. This composition is obtainable in the Kent hop districts (*C. W.*). It has the consistency of thick cream, and is valuable either for brushing into trees, slightly diluted, or for application in a much diluted form by means of syringes or engines. At the same time it is desirable to keep the branches and twigs of the trees free from lichens and mossy growths, and for this quicklime should be thrown all over the trees upon a foggy day in the early winter, as has been recommended in other monographs.

It is most desirable to keep the grass very short all round the trees in orchards, either fed close by sheep or brushed off, and to remove all stones, rubbish, and weeds. With regard to apple trees upon cultivated land, they should be dug round deeply in the late autumn, and hoed deeply in the early spring with lime, lime ashes, or earth, ashes or sawdust steeped in paraffin oil or carbolic acid, dug or hoed in.

Remedies. No practical remedies can be suggested for adoption in the case of orchards and plantations. In gardens it might be possible to dislodge the beetles before they could lay eggs by shaking espaliers, half-standards, bush trees, and cordons.

Fortunately these weevils are very subject to be attacked by a parasite known as *Pimpla pomorum*, of the family of Ichneumonidæ, and by another species of *Bracon* of the same family, which deposit their eggs in the larvæ ('Reports on Insects Injurious to Crops,' by Charles Whitehead, Esq., F.Z.S.).

AN'THONY'S FIRE, Saint (-to-nĭz). See ERYSIPELAS.

ANTHOSENZ (*Dr Hess*, Berlin). General tonic and anodyne balsam. Oil of cloves, 4 parts; oil of geranium, 2 parts; pine-apple essence, 1 part; spirit, 50 parts; coloured with alkanet root (*Hager*).

ANTHRACENE. $C_{14}H_{10}$. This hydrocarbon exists in the high-boiling portion of coal-tar.

It was discovered in 1832 by Dumas and Laurent, and described as para-naphthalene. In 1887 Fritsche found that it occurred in coal-tar, and in 1868 Graebe and Liebermann ('Berl. Berichte,' 1868, p. 49) proved that alizarin could be obtained synthetically from it. See ALIZARIN.

It is formed artificially by passing benzyl-toluene over heated lead oxide:

$$C_6H_5.CH_2.C_6H_4.CH_3 = C_6H_4\left\langle\begin{matrix}CH\\ |\\ CH\end{matrix}\right\rangle C_6H_4 + 2H_2;$$

or by heating liquid phenyl-tolyl ketone with zinc-dust:

$$C_6H_5.CO.C_6H_4.CH_3 = C_6H_4\left\langle\begin{matrix}CH\\ |\\ CH\end{matrix}\right\rangle C_6H_4 + H_2O.$$

When oxidised with potassium bichromate, anthracene is converted into anthraquinone, $C_6H_4\left\langle\begin{matrix}CO\\ CO\end{matrix}\right\rangle C_6H_4$ (see ALIZARIN), which can be again reduced to anthracene by means of zinc-dust.

The synthesis of anthraquinone by heating phthalyl dichloride to 220° C. with benzene and zinc-dust—

$$C_6H_4\left\langle\begin{matrix}COCl\\ COCl\end{matrix}\right. + C_6H_6 = C_6H_4\left\langle\begin{matrix}CO\\ CO\end{matrix}\right\rangle C_6H_4 + 2HCl$$

—gives the clue to the constitution usually adopted for this body and for anthracene (the CO- or CH- groups occupying the *o*-position in at least one of the benzene nuclei).

Properties. Anthracene crystallises in colourless rhombic tables, having a blue fluorescence. It melts at 213° C., and boils somewhat over 360° C. It is quite insoluble in water, and only slightly soluble in alcohol and ether. Warm benzene dissolves it more readily.

According to Versmann ('Chem. News,' xxx, p. 204), 100 parts at 15° C. of—

Alcohol, sp. gr. 0·800	dissolve 0·591	anthracene.
„ 0·825	„ 0·574	„
„ 0·830	„ 0·491	„
„ 0·835	„ 0·475	„
„ 0·840	„ 0·460	„
„ 0·850	„ 0·423	„
Ether	1·175	„
Chloroform . . .	1·736	„
Carbon bisulphide . .	1·478	„
Glacial acetic acid . .	0·444	„
Benzene	1·668	„
Petroleum	0·394	„

Bechi finds that 100 parts of—

(*a*) Absolute alcohol at 16° C. dissolve 0·076, at a boiling temperature 0·083 parts of anthracene;

(*b*) Toluene at 15·5° C. dissolve 0·092, at 100° C. 12·94 parts of anthracene.

These values may be found useful in the treatment of crude anthracene.

When dissolved in benzene and exposed to sunlight, anthracene is converted into an isomeric modification, para-anthracene, which is only very slightly soluble in alcohol, ether, and benzene, and is unacted on by strong acids. It fuses at 244° C., and is at the same time converted into ordinary anthracene. Sulphuric acid dissolves anthracene to a greenish solution. At a higher temperature sulphonic acids are formed. See Alizarin.

Anthracene dihydride, $C_{14}H_{12}$, and anthracene hexahydride, $C_{14}H_{16}$, occur in coal-tar, and can be formed synthetically. Mono-methyl-anthracene, $C_{14}H_9.CH_3$, likewise occurs in coal-tar (*Japp* and *Schultz*, 'Berl. Ber.,' 1877, p. 1049).

With chlorine and bromine anthracene forms addition and substitution products. The dibromide, $C_{14}H_8Br_2$, when oxidised with potassium dichromate, gives dibromo-anthraquinone, $C_{14}H_6Br_2O_2$, which on treatment with caustic potash is converted into alizarin, $C_{14}H_6(OH)_2O_2$ (dihydroxy-anthraquinone). By hot dilute nitric acid anthracene is converted into dinitro-anthraquinone, $C_{14}H_6(NO_2)_2O_2$, which crystallises in purple rhomboidal plates.

A benzene solution of picric acid, added to anthracene dissolved in the same liquid, gives ruby-red crystals of picrate of anthracene, $C_{14}H_{10} . C_6H_2(NO_2)_3OH$; M. Pt. 170° C. (338° F.).

Manuf. and Prep. Anthracene, as already seen, is contained in the highest boiling fraction which comes over in coal-tar distillation (which *see*), viz. that which distils over above 270° C. It may be well to recapitulate here the fractions into which crude coal-tar is first divided; these are—

1. First runnings, up to 105° or 110° C. (221°—230° F.).
2. Light oil, up to 210° C. (410° F.).
3. Carbolic oil (for phenol and naphthalene), up to 240° C. (464° F.).
4. Creosote oil, up to 270° C. (518° F.).
5. Anthracene oil, above 270° C. (518° F.).

The fifth portion of the distillate deposits crystals of anthracene and other compounds on being left to itself, so that the mass has the consistence of butter. The mixture is extremely complex, containing naphthalene, methyl-naphthalene, anthracene, phenanthrene, acenaphthene, diphenyl, methyl-anthracene, pyrene, chrysene, retene, fluorene, fluoranthene, chrysogene, benzoerythrene, carbazol, and acridine, which are all solid; besides high-boiling oils, about which very little is known.

6. The most formidable impurities in crude anthracene are—

(1) Naphthalene, $C_{10}H_8$, and phenanthrene, $C_{14}H_{10}$. These are mainly removed when the crude anthracene is washed.

(2) Methyl-anthracene, $C_{15}H_{12}$. This hydrocarbon occurs in anthracene obtained by distilling the residues from the naphtha used in washing crude anthracene. It is much dreaded by alizarin manufacturers, on account of the obnoxious shade which its derivatives give to alizarin.

(3) Chrysene, $C_{18}H_{12}$. This is always present in commercial anthracene, since it is practically insoluble in the solvents used for washing crude anthracene. For the same reason it is reckoned as anthracene in the extraction methods of analysis.

(4) Carbazol, $\begin{matrix}C_6H_4\\ |\\ C_6H_4\end{matrix}\!\!>\!NH$. This substance forms 10%—12% of washed anthracene. It is best separated by distilling the anthracene with caustic potash. The carbazol combines with the latter, forming a compound $C_{12}H_8NK$, which is decomposed on treatment with water, carbazol and caustic potash being reproduced.

(5) Imido-phenyl-naphthyl, $\begin{matrix}C_6H_4\\ |\\ C_{10}H_6\end{matrix}\!\!>\!NH$, occurs in the residue left on redistilling anthracene, and may be separated by sublimation.

(6) Paraffin (coal-tar), CnH_{2n+2}. This substance sometimes occurs in crude anthracene, and gives great trouble to alizarin manufacturers by hindering filtering operations. It is less soluble and melts at a higher temperature than petroleum paraffin.

(7) Acridine, $C_{13}H_9N$.

The first operation in the purification of the anthracene in anthracene oil consists in separating the solid from the liquid portion.

Before this is done, however, the mass should be left to itself for at least three or four days, to allow the anthracene to crystallise out as completely as possible. The simplest way of effecting the preliminary filtration is to force the buttery mass into strong canvas bags, the oil which passes through being received into a tank. This oily portion contains some anthracene, and is sometimes redistilled. When the cylindrical bags are full, their ends are untied and the contents removed. A more thorough separation can be effected by using some of the different forms of filter-presses now so largely employed in chemical manufactures. This first filtration simply separates the solid crude anthracene from the oils with which it is mixed. In the next operation the mixed solids are submitted to a gradually increasing pressure (up to 300 atmos.) in an hydraulic press, heat being at the same time applied. The effect of this is to melt and squeeze out the naphthalene, the less fusible anthracene remaining behind in the solid state. The heat for this purpose may be applied by surrounding

the press with a wooden jacket and introducing steam. This method of procedure, however, is not very clean; and, moreover, the anthracene becomes mixed with condensed steam. A better plan is to alternate the cakes of anthracene (from the filter-presses) with hollow plates, through which steam circulates, the arrangement being similar to that used in the manufacture of stearin (see BUTTERINE). In this way 50% to 52% anthracene can be obtained in the pressed cake, whilst only 35% to 36% is possible when a steam-jacket is used (*Lunge*).

The next purification consists in washing the anthracene cake with naphtha, to dissolve phenanthrene and some naphthalene, phenol, and unknown oils. The naphtha for this purpose must be so chosen that it has little solvent action on the anthracene. The 'solvent naphtha' obtained in distilling light coal-tar oils, which consists mainly of xylenes, pseudo-cumene, and mesitylene, and boils at 120°—190° C. (248°—374° F.), is very suitable. In England petroleum spirit of under 90° C. (194° F.) B. Pt. is sometimes used, that boiling at 100° C. (212° F.) dissolving too much anthracene. Before treatment with the solvent the anthracene cake must of course be powdered, this being done in any suitable mill. It is then charged into a boiler fitted with a stirring arrangement, together with the solvent naphtha, and gently heated, with agitation, for some hours. At the end of this time it is forced through an iron box, fitted with a grating covered with canvas, which filters off the anthracene. The contaminated naphtha runs into a reservoir, and is redistilled and used over again. The residue left behind is burned for the sake of lamp-black.

The nature of the solvent, as above stated, is of considerable importance. The following table exhibits the solvent powers of petroleum spirit and benzene respectively:

	Petroleum Spirit.	Benzene.
B. Pt.	70°—100° C.	80°—100° C.
Anthracene	0·115%	0·976%
Phenanthrene	3·206%	21·94%
Carbazol	0·016%	0·51%

Creosote oil is also employed for washing crude anthracene. Lunge ('Coal-tar and Ammonia') describes—more or less as follows—a process in which this solvent is used:—The first crude crystals, testing say 10% pure anthracene, are, after draining, mixed with an excess of creosote oil at a temperature of 80° C. The mixing being quite complete, the mass is allowed to cool down to 40° C., and the crystals then obtained are subjected to hot pressure, when they will yield 40% anthracene, the creosote oil having dissolved far more of the impurities than of real anthracene. The tepid mother-liquor is allowed to cool down to 25° C., and thus a second crop of poorer anthracene crystals is obtained; and a third quality is got by allowing the second mother-liquor to cool down to the ordinary temperature. The second product is redistilled with the press oil, and a further quantity of anthracene thus obtained. The third product is mixed with fresh crude anthracene.

Creosote oil is said to remove paraffin, one of the most troublesome impurities in crude anthracene. It resists the usual solvents and has a high melting-point, hence it cannot be removed by hot-pressing; and it withstands the oxidising agents generally used in converting anthracene into anthraquinone. The anthracene, after washing with the naphtha or other solvent, contains from 30% to 70% of the pure substance, according to whether the crude crystals have been well drained and hot-pressed or not. The richer product is sufficiently pure for the manufacture of alizarin (which *see*). A curious process formerly in use at Perkin's alizarin works consisted in mixing the crude anthracene with caustic potash and a little lime, and distilling at a red heat. The distillate contained 40% of anthracene. The potash was recovered by dissolving out the contents of the retorts with water, and boiling with lime. There was probably here a considerable loss of anthracene, but this method is the best for preparing the material from which to obtain the pure substance. Lunge states that very good results are obtained by simply fusing anthracene, previously purified by washing, with caustic soda. Anthracene of 60% can be got in this way. If, after distillation or fusion with potash, the anthracene is again washed with naphtha, the percentage of pure substance can be brought up to 70%, or even 80% or 90%. This further treatment is, however, too costly for alizarin manufacture. The oils straining from the presses are either mixed with creosote oil, or with hard pitch for making soft pitch, or are used themselves as lubricating oils. They may with advantage be redistilled, when a further yield of anthracene is obtained. Attempts have been made to increase this yield by passing the vapour over hot bricks, so as to break down the oily bodies into anthracene and other products.

Before being used for alizarin manufacture the anthracene must be brought into a fine state of division. This is effected by melting it in a large flat iron vessel and passing in super-heated steam. The mixed vapours of steam and anthracene then pass into a chamber where they meet with a spray of cold water, and are condensed,—the anthracene in the form of fine scales. Pure anthracene is best prepared from anthracene which has been distilled with potash, by washing with carbon disulphide and re-crystallising several times from petroleum spirit or benzene. Chemically pure anthracene should be prepared by reducing its derivatives (*e. g.* anthraquinone) with zinc-dust.

Statistics. The quantity of anthracene obtainable depends upon the nature of the tar. Scotch tar yields little or none, German tar 0·3% to 0·35%, North Country tar 0·5%, London tar 0·8% to 0·9% of the pure substance (*Lunge*).

W. H. Perkin ('Journ. Soc. Chem. Ind.,' 1885, p. 433) estimates the yearly output of the United Kingdom at 2000 tons of the pure substance per annum, an amount considerably in excess of that required for the manufacture of alizarin; hence processes for the manufacture of this substance from pitch, petroleum residues, or resin are not likely to be commercially successful (*Lunge*).

Estimation and Tests for. Owing to the high cost of anthracene and the very variable composition of the commercial product, a method of estimating the amount of contained anthracene is obviously of value. The best is undoubtedly Luck's, but it

requires some manipulative skill. The older extraction methods are still used; but in order that the results may be at all comparable it is necessary that the same method should be always followed, and that the name of the solvent, its temperature and specific gravity (in the case of alcohol), and the details of the process should be stated in the sale-note (*Lunge*).

Alcohol (*or Spirit*) *Test.* The anthracene is first well ground, and 20 grms. are weighed out and stirred in a beaker with 150 grms. of alcohol (sp. gr. 0·825). The beaker is then covered, and the mixture gradually heated to boiling, and then cooled to 18·5° C. (60° F.) by placing the beaker in water. At the end of an hour the liquid is filtered, and the residue on the filter washed with cold alcohol (at 15·5° C.) of the same strength as before, until the filtrate and washings measure 400 c.c., any sand which appears at the bottom of the beaker being kept back. The mass on the filter is now transferred to a tared watch-glass, dried at 100° C., and weighed. This weight is taken as pure anthracene. In order to estimate insoluble impurities, the weighed anthracene may be heated with enough alcohol to dissolve it, the solution filtered hot, and any residue weighed. If there is more than 1% (calculated on the original substance), the sample must be considered to be adulterated.

A determination of the melting-point of the purified anthracene should also be made. It should not be below 190° C. (374° F.). The test is made by drawing out a piece of glass tubing to a capillary tube, closed at one end, and packing it with the anthracene. The tube is then attached to the bulb of a good thermometer, and the two immersed in a paraffin bath whose temperature is gradually raised. The temperature at which the first drop runs down is noted. After the whole of the anthracene has become fluid the source of heat is removed, and the temperature at which solidification takes place observed. The mean of the two is taken as the melting-point.

Another method is to ascertain how much anthracene of standard melting-point (190° C.) can be obtained by treating the crude substance with an indefinite quantity of alcohol of 0·825 sp. gr. This is effected by first treating a weighed quantity of the crude substance exactly as before, and determining the yield of anthracene and the melting-point. If this latter is 190° C., nothing further is required. If it is above or below this, a fresh sample is taken and treated with less or more alcohol, as the case may be, and the yield and melting-point again determined. The percentage of anthracene of 190° C. melting-point can then be arrived at by calculation. Thus, suppose that in the first assay 40% of anthracene of 195° C. M. Pt. was obtained when the (weighed) sample was treated with 150 c.c. alcohol and washed to 400 c.c., and that in the second assay 49% of anthracene of 188° C. M. Pt. was obtained when the (same weight of) sample was treated with 100 c.c. alcohol and washed to 300 c.c.; then—

$$195 - 188 : 49 - 40 :: 195 - 190 : x$$

where $x = 6{\cdot}4$ = the amount to be added to the lower percentage in order to get the yield of anthracene of 190° C. M. Pt. In the above example this is 46·4.

Carbon Bisulphide Test. 10 grms. of the sample are shaken with 30 c.c. of carbon bisulphide, and allowed to stand at 15·5° C. for an hour. The residue is thrown on a filter and the bottle rinsed with an additional 30 c.c. of carbon bisulphide, any sand being left behind. The mass on the filter-paper is quickly pressed, first gently and afterwards in a press, dried at 100° C., and weighed as pure anthracene. Its melting-point should not be above 213° C. (383·4° F.).

Perkin treats 50 grms. of the crude anthracene with 10 fl. oz. petroleum spirit of 0·740 sp. gr., filters through canvas, and washes with another 20 fl. oz. of petroleum. The residue is then pressed as above, after which it is powdered and shaken for two or three minutes with 5 oz. of carbon bisulphide, when it is collected on a tared filter, dried, and weighed. The mean melting-point (see *above*) should lie between 200° C. and 212° C. (392° F. and 414° F.). This last test has been long in use. All the above extraction tests are, however, very inaccurate, since on the one hand a small amount of anthracene is always dissolved, whilst on the other chrysene, a constant impurity, is but slightly affected by the above solvents.

Tests depending on the Oxidation of Anthracene to Anthraquinone.—Luck's Test. 1 grm. of the crude anthracene is dissolved in 45 c.c. of boiling glacial acetic acid, the liquid filtered if necessary, heated to boiling, and a solution of 10 grms. of chromic acid [CrO_3(?)] in 5 c.c. of water, and 5 c.c. glacial acetic acid added slowly to the boiling liquid. After continued boiling the solution should have a greenish-yellow colour. It is now allowed to cool and gradually diluted with 150 c.c. of water, set aside for a few hours, and then filtered. The residue is washed, first with water, then with a hot, very dilute solution of caustic soda, and once more with water, and finally dried at 100° C. and weighed. The anthraquinone is removed as completely as possible from the filter, which is weighed separately, and its weight deducted from the total. Lastly, 0·01 grm. is added to allow for anthraquinone which has been dissolved.

A modification of the above is the test of Messrs Meister, Lucius, and Brüning ('Zeitschr. für Analyt. Chemie,' xvi, p. 61), sometimes known as the *Höchst* test. It is the most accurate method for the estimation of anthracene, and is carried out as follows:—1 grm. of the crude substance is dissolved in 45 c.c. of glacial acetic acid in a flask fitted with a reflux condenser, and to it there is added drop by drop a solution of 15 grms. chromic acid in 10 c.c. glacial acetic acid and 10 c.c. water. The addition of the latter should take 2 hours, and the liquid should be kept boiling for 2 hours more. It is then set aside for 12 hours, diluted with 400 c.c. of cold water, and set aside for another 3 hours. The precipitate is filtered off, washed first with cold water, then with hot dilute caustic soda, and finally with hot water. It is next rinsed into a dish, dried at 100° C., treated with 10 times its weight of fuming sulphuric acid of 68° Baumé (sp. gr. 1·88), and heated for 10 minutes at 100° C. on a water-bath. The dish is next placed in a damp situation until all the sulphuric anhydride has been converted into sulphuric acid by absorption of water, the

contents then diluted with 200 c.c. of water, filtered, and the quinone again washed successively with water, hot alkali, and water again. It is then transferred to a dish, dried at 100° C. and weighed. Lastly, the quinone is volatilised by heat, and the dish containing the ash and particles of coal again weighed. The difference represents pure anthraquinone. This, multiplied by 0·8558, will give the amount of pure anthracene in the 1 grm. taken.

Paraffin, which is greatly dreaded by the alizarin manufacturer on account of the trouble it gives in the purification of that dye, can be detected by heating 10 grms. of the anthracene with 200 grms. of sulphuric acid until all the pure substance is dissolved; any (coal-tar) paraffin which may be present will rise to the surface in oily drops. The liquid (after cooling) can be poured into 500 c.c. of water, the solution allowed to cool, and the paraffin skimmed off, dried with filter paper, and weighed. Scotch anthracenes contain from 2% to 5% (*Allen*, 'Commercial Organic Analysis,' 2nd ed., ii, p. 529).

A plan now used in some alizarin works for the valuation of anthracene intended for alizarin manufacture is to carry out the manufacturing process on a small scale. For this purpose 10 grms. of the sample are mixed with 20 grms. of potassium bichromate and added to 1 litre of water; 30 c.c. of sulphuric acid diluted with the same quantity of water are then gradually added in the course of an hour to the boiling liquid. The boiling is continued for another three hours, loss by evaporation being made good by the addition of water. The liquid is filtered, and the crude anthraquinone—containing 40% to 50% of pure substance—washed, dried at 100° C., and weighed. At this point a little of the residue should be dissolved in benzene, allowed to crystallise on a glass slide, and examined with the microscope. Any unoxidised anthracene will be seen as tabular overlying plates. The crude anthraquinone is next heated in a dish with four times its weight of strong sulphuric acid for 1½ hours, with frequent stirring, whereby unattacked hydrocarbons are converted into soluble compounds. The dish is next placed under a bell-jar alongside a dish of boiling water. By this means a gradual dilution takes place, and the crystallisation of the anthraquinone is facilitated. After twelve hours the contents of the dish are poured into 500 c.c. of water, and the mixture is heated to boiling. The anthraquinone is then filtered off, washed, treated with boiling soda (sp. gr. 1·04), again washed, dried at 100° C., and weighed. It then forms a greenish-grey crystalline mass, and contains 80% to 95% of pure anthraquinone. If necessary, an aliquot part may be weighed out, purified as under the '*Höchst* test,' and weighed again; the percentage of pure anthracene in the substance taken can then be easily calculated. The percentage of anthracene in coal-tar can be determined by distilling a litre of the liquid, and estimating the anthracene in the portion which comes over between 270° C. (518° F.) and the end of the distillation.

It is best to reject that portion which comes over immediately before coking, as it contains much resin, and would not be available in anthracene manufacture (*Watson Smith*).

ANTHRACITE [Eng., Fr.]. *Syn.* GLANCE COAL, STONE COAL‡, MINERAL CHARCOAL*; ANTHRACITES, L.; GLANZKOHLE, Ger. This, the most highly mineralised form of vegetation, is a species of coal iron-black to velvet-black in appearance, and with a semi-metallic lustre; it is hard and brittle, contains over 90% of carbon, and has a specific gravity of 1·35 to 1·70. Anthracite burns without fusing, giving out neither smoke nor smell, emits an intense heat, and leaves scarcely any ash. It is, however, difficult to kindle, and requires a lively draught for its consumption. It is the common (coal) fuel in the United States of America, although not much employed in Europe (chiefly in a few iron-works and steam-furnaces). Its adoption here would tend to remove the smoke nuisance, and would effect a large annual saving to the community. By contracting the throat of the chimney a little and avoiding the use of the poker, it may be burnt in a common grate. The Americans use a little charcoal as kindle, and seldom have to replenish their fires oftener than once or twice a day.

The term CULM is applied both to an inferior kind of anthracite, only worked for making lime and for mixing with clay, and also to the small pieces obtained in working beds of true anthracite. It is also known as *Blind coal, Glance coal,* and *Kilkenny coal.* Culm is the term generally applied to anthracite in our parliamentary returns. For the analysis, geology, calorific value, &c. of anthracite, see also COAL, EVAPORATION, FUEL, HEAT, &c.

De la Beche describes anthracite as "a variety of coal containing a larger proportion of carbon and less bituminous matter than common coal"; and Geikie, in his larger text-book, says: "It is a coal from which the bituminous parts have been eliminated. It occurs in beds like ordinary coal, but in positions where probably it has been subjected to some change whereby its volatile constituents have been expelled." He adds at another place: "Some lower Silurian shales are black from diffused anthracite, and have, in consequence, led to fruitless searches for coal."

In the 'Memoirs of the Geological Survey' we read: "We see the same series of coal-beds becoming so altered in their horizontal range that a set of beds bituminous in one locality is observed gradually to change into anthracitic in another. Taking the coal measures of South Wales and Monmouthshire, we have a series of accumulations in which the coal-beds become not only more anthracitic towards the west, but also exhibit this change in a plane which may be considered as dipping south-south-east, at a moderate angle, the amount of which is not yet clearly ascertained, so that, in the natural sections afforded, we have bituminous coals in the high grounds and anthracite coals beneath. This fact is readily observed either in the Neath or Swansea valleys, where we have bituminous coals on the south and anthracite on the north; and more bituminous coal-beds on the heights than beneath, some distance up these valleys, those of the Nedd and Tawe. Though the terms bituminous coal and anthracite have been

applied to marked differences, the chances are that there is no sudden modification to be seen. To some of the intermediate kinds the term 'free burning' has been given, and thus three chief differences have been recognised."

Anthracite occurs in this country largely in South Wales, also—in lesser quantities—at Walsall in Staffordshire, Bideford in Devonshire, in Ireland, and near Edinburgh. It is also found in the coal measures of France and Belgium, and is largely developed in the great coal-field of Pennsylvania. Professor H. D. Rogers, 'Transactions of the American Geologists,' states that in the great Apalachian coal-field, extending 720 miles, with a chief breadth of 180 miles, the coal is bituminous towards the western limit, where it is level and unbroken, becoming anthracitic towards the south-west, where it is disturbed.

The subjoined analyses (taken from 'Ure's Dictionary') of bituminous and anthracitic coals will suffice to show the difference between them:

Locality.	Name of Coal.	Carbon.	Volatile matter.	Ashes.
	Bituminous.			
Birtley Works, Newcastle-on-Tyne	. . . .	60·50	35·50	4·00
Alfreton, Derbyshire	. . . .	52·46	42·50	2·04
	Anthracite.			
Neath Abbey	Pwlferon Vein, 5th bed	91·08	8·00	0·92
Swansea	Peacock Coal	89·00	7·50	3·50
Ystalyfera	Brass Vein	92·46	6·04	1·50
Cwm Neath	Nine-feet Vein	93·12	5·22	1·50
France	Anthracite, common	79·15	7·35	13·25
"	Côte d'Or	82·60	8·60	8·80
"	Mais Saize	83·80	7·50	9·50
Pennsylvania	Beaver Meadow	92·30	6·42	1·28
"	Shenoweth Vein	94·10	1·40	4·50
"	Black Spring Gap	80·57	7·15	3·28
"	Nealey's Tunnel	89·20	5.40	5·40
Massachusetts	Mansfield Mine	97·00	10·50	3·00
Rhode Island	Portsmouth Mine	85·84	10·50	3·66
Westphalia	Shafberg, Alexander Seam	82·02	8·69	9·29

Principal Localities of Anthracite and Anthracitous Coal.

Europe.	Specific Gravity.	Weight of a Cubic Yard in lbs.
South Wales—Swansea	1·263	2131
Cyfarthfa	1·337	2256
Ynscedwin	1·354	2284
Average	1·445	2278
Ireland—Mean	1·445	2376
France—Allier	1·380	2207
Tantal	1·390	2283
Brassac	1·430	2413
Belgium—Mons	1·307	2105
Westphalia	1·305	2278
Prussian Saxony	1·466	2474
Saxony	1·300	2193
Average of Europe		2281
America.		
Pennsylvania—		
Lyken's Valley	1·327	2240
Lebanon Co., Grey Vein	1·379	2327
Schuylkin Co., Lorberry Creek	1·472	2484
Pottsville, Sharp Mount	1·412	2382
Peach	1·446	2440
Salem Vein	1·574	2649
Tamaqua, North Vein	1·600	2700
Maunch Chunk	1·550	2615
Nesquehoning	1·558	2646

America.	Specific Gravity.	Weight of a Cubic Yard in lbs.
Pennsylvania—		
Wilkesbarre, best	1·472	2884
West Mahoney	1·371	2313
Beaver Meadow	1·600	2700
Girardville	1·600	2700
Hazelton	1·550	2615
Broad Mountain	1·700	2869
Lackawanna	1·609	2715
Massachusetts—Mansfield	1·710	2882
Rhode Island—Portsmouth	1·810	3054
Average in United States		2601

The calorific value of anthracite coal is well shown by the following results of experiments made by Dr. Fyfe with the object of comparing the evaporative powers of Scotch and English bituminous coals with that of anthracite. These were carried out in a high-pressure boiler of a 4-horse engine, having a grate with 8·15 square feet of surface; also in a waggon-shaped copper boiler, open to the air, surface 18 feet, grate 1·55.

The evaporative power of anthracite under certain conditions has been fully established. *See next page.*

ANTHRACOM'ETER. *Syn.* Anthracom'etrum, L.; Anthracomètre, Fr.; Kohlensäuremesser, Ger. An apparatus used to determine the heating power or commercial value of

Kind of Fuel employed.	Pounds burnt per hour on the Grate.	Duration of the Trial in hours.	Temperature of the Water.	Pounds of Water evaporated from the initial Temperature by 1 lb. of Coal.	Pounds of Water at 212° from 1 lb. of Coal.	Coal per hour on one square foot of Grate.	Time in seconds of consuming 1 lb. of Coal.	Pounds evaporated per hour from each sq. ft. of surface.	Remarks.
Middlerig Scotch coal .	81·33	9	45°	6·66	7·74	10·00	44·27	...	Pressure 17 lbs. per square inch.
Scotch coal, different variety from preceding	108	5	170°	6·62	6·89	13·25	33·33	...	Ditto.
ANTHRACITE	47·94	8½	45°	8·73	10·10	5·88	75·09	...	Ditto.
Scotch coal, from near Edinburgh	8·24	8½	50°	5·38	6·90	5·31	436·89	3·15	Lower pressure, open copper boiler.
English bituminous coal	6·07	8·4	50°	7·84	9·07	3·91	503·08	3·06	Ditto.

coal, or other fuel; also an instrument for finding the proportion of carbonic acid in any gaseous mixture.

ANTHRAROBIN. A compound discovered by C. Liebermann. Made by boiling commercial alizarin or purpurin with zinc-dust and dilute ammonia solution, filtering, adding hydrochloric acid to the solution, collecting, washing, and drying the precipitate.

Uses. In skin diseases as a substitute for chrysarobin or chrysophanic acid.

ANTHRAX. *Syn.* CHARBON, GLOSS ANTHRAX, APOPLEXIA SPLENETICA, CARBUNCULO CONTAGIOSA, &c., L.; CHARBON, CHANCRE À LA LANGUE, MAL DE SANG, SANG DE RATE, TYPHOMIE, FIÈVRE PUTRIDE, &c., Fr.; MILZ-BRAND, MILZBRAND-FIEBER, PETECHIAL TYPHUS, PESTFIEBER, Ger.; CARBONE, FEBBRE CARBONCOLARA, &c., Ital.; apoplexy of the spleen; malignant sore-throat; known in India as Loodiana disease, and in South Africa as horse sickness; in sheep as splenic apoplexy; in America, splenic fever, Texan fever, trembles, &c.

The term charbon is used by the French veterinary surgeons because the parts of the body in which the disease is localised are of a black colour. Anthrax (a burning coal) is the term now most generally used and applied to what is otherwise known as splenic fever.

Anthrax is a peculiarly dangerous and fatal disease of man and animals, more especially of the herbivora and birds, caused, as there is now no longer any reason to doubt, by a specific organism, the *Bacillus anthracis,* which develops and is propagated in the blood of the affected animal, and which is capable of transmission from one animal to another by inoculation. The following facts regarding the disease are largely taken from 'Williams's Veterinary Medicine,' 5th ed.:

History. Anthrax, though but recently thoroughly investigated, appears to have been known from very early times, the seventeenth and eighteenth centuries being specially remarkable for the ravages caused by it. It is said that in the year 1617 over 60,000 persons died of the disease in the neighbourhood of Naples as the result of eating the flesh of infected animals. In 1731 it broke out in several provinces of France, and from 1757 to 1800 there were no less than six serious epidemics of the disease in that country, which attacked all domesticated animals. During the present century there have been many serious outbreaks in France, and the disease has been carefully studied in that country by many competent observers. We are chiefly indebted to Pasteur and Chauveau in France and Koch in Germany for our knowledge of the nature and causes of the disease.

Ætiology. Temperature and moisture appear to have a very marked influence upon the distribution of anthrax, and the experience derived from the outbreaks of the disease in France tend to show that a high temperature, especially if preceded by a damp or moist atmosphere, is favorable to the development of charbon. Land liable to inundation, bogs, morasses, and soils in which the subsoil is loaded with stagnant water, are apparently favorable to the development of the malady.

"Observers who have closely watched these affections in England, where they seldom appear spontaneously in the horse, almost unanimously conclude that in cattle and sheep they are due to dietetic errors; more particularly to sudden and violent changes of diet, whether that change be from a poor to a highly nutritious, more particularly a nitrogenous, diet; from a dry and good food to watery, unripe provender; to damaged food of any kind; the influence of undrained lands; defective ventilation and drainage of stables; to food and water contaminated with the morbid products of animals which have died from blood disease. In one remarkable outbreak which came immediately under my notice (*Williams*) the disease appeared amongst sucking calves of the pure shorthorn breed, and which had never partaken of other food than that obtained by sucking, the dams remaining healthy."

"Anthrax is also disseminated through the agency of flies, and Bollinger, who has observed that the disease is often most prevalent when flies are in the greatest abundance, has induced it in rabbits by inoculating them with flies caught on the carcases of animals dead from anthrax. The flies, however, resist the influence of the virus, although bacteridæ are found in them."

It has also been found that earthworms may play a not unimportant part in spreading the in-

fection of anthrax, by bringing to the surface organisms derived from the dead animals which have been buried even at a considerable depth, and so fouling the herbage.

Symptoms in the Horse. The animal appears dull and walks with a heavy, feeble step, ultimately falling prostrate in a state of somnolence; if standing, it will rest its body against the side of the stall or other support; lastly, it becomes restive, stamps, turns its head towards the flanks, and exhibits signs of colic. The skin is hot; the coat rough and bristling in parts; there are tremblings of the muscles, and a flow of saliva from the mouth; the animal has an alternation of hot and cold sweats; the lymphatics of the groin are swollen, and these symptoms are followed by great excitement and irritability, to which more or less complete unconsciousness succeeds; the pulse is small and thready; the respirations often irregular and accompanied with roaring. These symptoms slowly disappear or may be succeeded by an eruption, or may become aggravated, in which case the animal grinds its teeth; has severe colic; rolls about and exhibits violent convulsive movements of the head and neck; the heart-beats become violent and irregular; the pulse small and thready; the respiration tumultuous; the nostrils dilated, and blood and yellow serous matter flow from the nose; the mouth is filled with mucous foam; the tongue dark and swollen, and tears fall from the eyes, which are sunken and haggard; the belly is tympanitic and sensitive to the touch; the excrement is often liquid and bloody; the skin becomes cold, and gradually, the muscular force becoming exhausted, the animal falls, and after convulsions, particularly of the neck and extremities, a state of calm succeeds which is the immediate precursor of death.

The disease may terminate in from 6 to 48 hours after the manifestation of the first symptoms. The ordinary time is from 12 to 24 hours unless external eruption eliminates the morbid material from the body.

In horned cattle the symptoms are very similar to those in the horse. "The ox suddenly goes off its feed; rumination is suspended; there are rigors and tremblings; partial sweats bedew the body, which is alternately hot and cold. There is the same injection of the mucous membranes as described in the horse, and the same colic, convulsions, inability to stand, and bloody fluid discharges from the anus. In some animals the excitement is so great that it is dangerous to approach them."

True anthrax in sheep is not very common in England, but braxy—an anthracoid disease—is a form of septicæmia which greatly resembles anthrax in its post-mortem appearances.

Anthrax in the dog is usually the result of eating the flesh of animals which have died of the disease, though not in all cases. The chief symptoms are vomiting, colic, bloody diarrhœa, convulsions, and great prostration. The local symptoms are swelling of the throat and great soreness of the tongue and mouth and the formation of a tumour, usually about the lips, without any increase of temperature or sensibility or change in the colour of the skin. In a few hours this tumour develops to such a size as to occupy all the surrounding parts, and may involve the trachea, rendering respiration very difficult, and often causing suffocation. Ultimately the tumour exhibits numerous circular spots of a reddish-violet colour, and a gangrenous appearance.

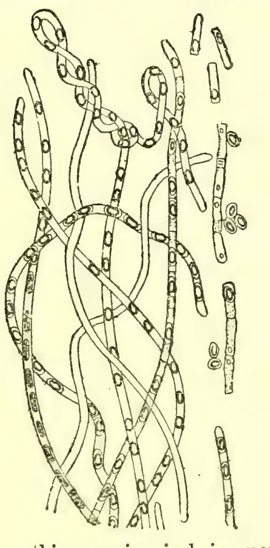
Anthrax in the pig, anthracoid erysipelas, blue sickness, pig typhoid, &c., has been shown by Klein to differ in many particulars from anthrax. Anthrax fever is as rapidly fatal in the pig as in other animals, and the symptoms are much the same.

Gloss-anthrax, malignant sore-throat, anthracoid angina, is the usual result of eating the flesh of animals which have died of the disease. The throat swells enormously, as also the pharynx, larynx, tongue, &c. There is also the same bloody discharge from the bowel, with great exhaustion. Anthrax with tumour or carbuncular anthrax seems to be somewhat rare in the pig.

Poultry are also affected by the disease, which manifests itself in much the same way as in other animals.

Pathology of Anthrax. Inasmuch as anthrax is perhaps the disease *par excellence* in which the intervention of a pathogenic organism has been clearly demonstrated, it may be well to enter into some detail regarding it.

The blood of animals dead of anthrax, and especially that of the spleen, was shown by Koch to contain numbers of bacilli having a close general resemblance to *Bacillus subtilis*, but



differing from this organism in being non-motile; it was further found that if a mouse (an animal peculiarly susceptible to fatal anthrax) were inoculated with the blood of an animal dead of the disease, that these same organisms increased and multiplied enormously in its blood; further, Koch succeeded in cultivating them on nutrient gelatine (see BACTERIOLOGY) and watching their growth and mode of development. He saw that the rods multiply by division, and that they grow into long homogeneous-looking, straight or twisted filaments in which, after some time and with free access of air, bright oval spores make their appearance, while the filaments become homogeneous and

swollen. These spores become free, and when artificially cultivated or injected into the blood of a rodent animal, germinate into the characteristic bacilli. These elongate and divide; and in artificial cultures again grow into the long leptothrix filaments which again form spores (*Klein*). The vitality of these spores is very great, and they may be kept for years without losing their powers of germinating; but whatever be the medium in which they are grown, unless there be free access of oxygen, the filaments do not produce spores. The capacity of the organism for producing these sporeless filaments is limited, and after a time degeneration sets in and the whole mass of filaments breaks up into *débris*, and if the degeneration be complete, a solution containing this *débris* is innocuous to rodents; but if any sound protoplasmic elements be present, they will propagate themselves in a suitable medium and reproduce an organism fatal to rodents and to sheep.

In the body of an animal the *Bacillus anthracis* appears to derive its oxygen from the blood, and this in a great measure will account for the appearance of the blood after death and for some of the phenomena of the disease. The degeneration of the bacillus and the inability of the filaments to produce spores causes the ultimate destruction of the poison in animals which have died of the disease and have been buried unopened; and this fact has been urged as disproving Pasteur's statement as to the action of earthworms. If the bacilli are dried in a very thin layer they are invariably killed, but the spores remain unaltered.

Pasteur found that when the *Bacillus anthracis* was cultivated for a long time on chicken broth at 42°—43° C. it appeared to lose its virulence, and instead of killing an animal inoculated with it produced illness only, and that after this had passed off the animals were protected for some time against the disease. This 'vaccine' is, however, fatal to rodents, and it is possible to prepare a culture of anthrax which will not kill mice and will not produce fatal anthrax in guinea-pigs, but which, nevertheless, fails to give the latter any immunity soever, and it is believed to be impossible to render a rodent safe from the disease.

The above facts will suffice to show the basis of the arguments for inoculation and the difficulties attending it. The period of protection is but short, and there is as yet some little doubt as to its practical value to the cattle owner.

Bacillus anthracis is capable of growing well outside the body, and, when well supplied with oxygen, of forming spores which may be regarded as the permanent seeds, and, from what has been stated, it will be clear how great is the danger caused by an animal dying of the disease upon a pasture frequented by others. The excreta, blood, urine, and other discharges are all contaminated with the poison, and these will suffice to foul the soil and render it fatal to any other animals grazing upon it.

Inoculation against Anthrax. The inoculation of animals with so-called 'attenuated virus' as a protection against the disease is a question the whole details of which cannot be given here, as there are considerable differences of opinion on the subject. The following is a very brief outline of some of the more important facts on which the advocates of inoculation urge its use:

"It is necessary to bear in mind that, by passing the bacillus through different species of animals, it becomes endowed with different qualities, and that bacilli which are fatal to some are not fatal to all animals. While, for instance, the blood bacillus of the sheep or cattle dead of anthrax invariably produces death when inoculated into cattle or sheep, after passing through white-mice it loses its virulence for sheep and cattle. The blood of white-mice dead of anthrax does not kill sheep; it produces only a transitory illness, and the animals are, for some time at least, protected against virulent anthrax. The blood of the guinea-pig dead of anthrax produces illness, sometimes death, in cattle, but as a rule does not kill (*Burdon-Sanderson* and *Duguid*), and the blood of the Biscachia of South America does not kill cattle, while it gives them a transitory illness and after this immunity for a time (*Roy*, 'Nature,' Dec. 1883).

QUARTER-ILL, BLACK-LEG, STRIKE, SYMPTOMATIC ANTHRAX, QUARTER-EVIL; CHARBON SYMPTOMATIQUE, Fr.; RAUSCHBRAND, Ger. A form of anthrax which is not uncommon in cattle; generally fatal, and very infectious. It is characterised by hæmorrhagic effusion (or 'tumour') in the subcutaneous or intermuscular tissues of one or other, or both, anterior or posterior extremities, in consequence of which the movements of the animal so affected become greatly impeded. The animals generally die in the course of the second or third day after infection.

The bacilli are about the size of those of malignant anthrax, or a little thicker; they are rounded at their ends, and often include at one end a bright oval spore. This never occurs in the bacillus of malignant anthrax; the bacilli are either single or form short chains; some of the bacilli are motile (*Klein*).

Inoculations into the subcutaneous tissues of guinea-pigs, rabbits, sheep, and calves always prove fatal, the same hæmorrhagic effusions being produced,

Injections of small quantities of bacillus containing material into the veins produces only a slight febrile disorder; large doses produce death. Animals in which by intravenous injection of small doses slight illness has been produced are afterwards protected against the fatal dose, but minimal doses injected subcutaneously also produce only a slight transitory swelling, and the animal so treated is afterwards protected against the fatal dose (*Arloing*, *Cornevin*, *Thomas*, and *Klein*, quoted by *Klein*).

Anthrax in Man. MALIGNANT PUSTULE, WOOLSORTER'S DISEASE, SIBERIAN PLAGUE, is invariably the result of direct or indirect contagion, and may arise from the consumption of the flesh of animals which have died of anthrax, or from the taking into the body of the spores of the bacillus, which develop in the blood and organs of the individual and give rise to the characteristic symptoms. As seen in England it occurs chiefly among those engaged in certain trades, especially workers in wool and horsehair, and tallow workers, particularly those who handle mutton fat. It is

unnecessary here to enter into detail, but it will suffice to say that the cause of the disease in persons engaged in these trades is undoubtedly the taking into their bodies of the spores of the anthrax bacillus derived from the dirty wool and hair which it is their business to handle. Russian horsehair has had an evil reputation in this respect for more than a century, and so great is the risk that a French authority, writing in 1777, says of the horsehair workers: "Indeed, it is seldom that they pursue this trade long without suffering from it, and many die. They have observed that the hair whose manufacture is most dangerous is that imported from Russia."

The prognosis in cases of anthrax in man is very bad, and though there is some reason to believe that early opening of the pustules and cauterisation with crystalline carbolic acid is of some service, the subjects of the disease generally die.

Treatment in Animals. Considering the virulent nature of the disease, very little is to be expected from treatment. According to Williams, in some cases fomentation of the extravasation with hot water and dressing with carbolised oil (1 part of carbolic acid to 4 parts of sweet oil) is sometimes useful. Potassium chlorate has been found to have a marked effect in improving the condition of the blood, and Williams prescribes for young stock a draught consisting of 3 dr. of potassic chlorate dissolved in a pint of water three times a day. An extra drachm may be given to full-grown animals, but care must be exercised, as it is liable to produce intestinal irritation.

In India the internal administration of carbolic acid has been found to be of service. Purgatives should not be given, and it is very desirable to assist the animal to resist the disease by giving tonics and good, easily-digested food.

Prevention. In dealing with a disease so fatal as anthrax, prevention is all-important. Pastures known to be infected must be avoided, and all the conditions indicated already as favoring the production of the disease. Above all, the greatest care must be exercised in the disposal of the bodies of animals which have died of the disease, and considering that the excreta of a diseased beast poison the herbage, bedding, &c., the complete and early isolation or destruction of infected animals is desirable.

The Anthrax Order of 1886 contains a number of stringent provisions regarding animals affected with anthrax; prohibits their being moved from place to place; prohibits the removal or use of any fodder, bedding, litter, utensils and the like, which may be considered infected by contact with diseased animals, and contains directions for the destruction of such infected material and the proper disinfection of stables, cowsheds, and other places in which diseased animals have been placed, and for the burial, disinfection, and destruction of the carcases of animals dead of the disease.

Under Section 6 of the Contagious Diseases (Animals) Act, 1886, the slaughter of diseased animals and the compensation of their owners out of the local rates is provided for. See CONTAGIOUS DISEASE OF ANIMALS.

ANTHROPHORES. Bougies made of spiral spring wire, coated with gelatine, and medicated with any desired substance. Mainly used for disorders of the urethra.

ANTHYPNOTICS (-thĭp-). *Syn.* ANTIHYPNOT'ICS (-hĭp-), &c. See AGRIPNOTICS.

AN'TI-. [Gr., ἀντι, against.] In *composition*, before, against, contrary to, corrective of, &c., more especially representing antagonism or opposition; whilst the Latin *ante-* is generally used in the sense of before, having reference to precedence either of place or time.

Anti- is a common prefix in English words derived from the Greek and Latin, especially those connected with pharmacology and medicine, the final *i* being either dropped or retained (but generally the first) before a, e, and h; as in antacid, antibilious, anti-emetic, anthelmintic, anti-scorbutic, antiseptic, &c., whether used as adjectives or substantives. These compounds, which are very numerous, are in general self-explanatory.

ANTI'ARINE [Eng., Fr.] *Syn.* AN'THIARINE, Eng., Fr.; ANTIARI'NA, ANTHIARI'NA, ANTIA''RIA, UPA'SIA (-zh'ă), L. The active principle of the upas poison of Java. A crystalline substance obtained from the juice of the upas tree, *Antiaris toxicaria.* Bettink gives it the formula $C_{14}H_{20}O_5$. It appears to be a neutral body, not precipitated by tannin, and may be obtained under the form of small pearly crystalline scales by careful evaporation.—*Prod.* About 3½% (*Mulder*).

Prop., &c. Soluble in 27 parts of boiling water; freely soluble in alcohol; scarcely so in ether; heat decomposes it; it is not precipitated by tannin. It is a frightful poison, to which no antidote is known. Even a minute quantity introduced into a wound rapidly brings on vomiting, convulsions, and death. It paralyses the cardiac nervous system.

Antiaris toxicaria, Lesch., a Malayan tree. The upas. The fresh juice is a virulent poison (*Ipoh*), and is used by the Malays to tip their arrows.

ANTIBIL'IOUS (-yus). *Syn.* ANTIBILIO'SUS, L.; ANTIBILIEUX, Fr. An epithet of medicines that are supposed to remove ailments depending on disordered action of the liver. Aperients, mercurials, and aloetic purgatives generally, belong to this class. See ABERNETHY, MEDICINES, BILE, PILLS, &c.

ANTICAR'DIUM. See REVIVER (Black).

ANTICHLOR. A term employed by bleachers and paper manufacturers to denote any substance which they make use of to eliminate the last portions of free chlorine which cloth and paper pulp are apt to retain after being bleached, and which, if left in, would cause the fibre of the cloth to rot, would obliterate documents written upon the paper thus prepared, and would injure the machinery used. The principal antichlors in use are (dilute solutions of) the sulphite and thiosulphate (commonly called hyposulphite) of sodium, Na_2SO_3 and $Na_2S_2O_3$; the products formed are the innocuous sulphate and chloride of sodium, which are readily removed by washing. Sulphide of calcium, prepared by boiling sulphur with milk of lime; Horsford's patent 'antichloride of lime,' an impure sulphite obtained by agitating milk of lime with the fumes of burning sulphur, and draining and air-drying the product; and proto-

chloride of tin, $SnCl_2$, have also been used. In the last case, however, it is necessary after the bleaching process to add carbonate of soda, in order to get rid of the free hydrochloric acid. See BLEACHING.

ANTI-CHOLERA ACID (*H. Ludwig*, Vienna; also an American preparation). "A proved cure and preventive of cholera." Diluted sulphuric acid, 1 part; wine, 5 parts; water, 10 parts (*Hager, Buchner*, and *Wittstein*).

ANTI-CHOLERA WATER (Eau Anticholérique de Duboc, Paris), for lead colic and a preventive of cholera. Composed of water with some brandy and ½ % of sulphuric acid (*Gmelin*).

ANTI-DAMPING FLUID. In lithography, preparations for enabling more than one impression to be taken with one damping.

1. Glycerine, 1 oz.; chloride of lime, 1 oz.; water, 2 oz.

2. Glycerine, 4 oz.; tartarate of potass, 1 oz.; gum, 1 oz.; water, 4 oz.

ANTIDOTE. An antidote is any remedy which, by its physical or chemical effect upon a poison, or in both ways, is capable of counteracting the physiological effects of that substance.

Most antidotal substances form with the poison insoluble or innocuous compounds. This is particularly the case with mineral poisons. Vegetable poisons cannot, as a rule, be counteracted in this way, and recourse must be had to drugs which are known to have an antagonistic action to the poison taken. In those cases in which it is possible to remove poisonous material, such as leaves, berries, seeds, roots, &c., by the use of emetics and purgatives, they should be employed; such treatment, though useful, is not so good in the case of alkaloidal poisons, which are generally absorbed before such assistance can be of any use.

The following table shows the most common poisons, and the antidotes most useful in each case.

Poison.	*Antidote.*
Arsenious acid (white arsenic)	Hydrated peroxide of iron, or light magnesia.
Oil of bitter almonds Hydrocyanic acid Cyanide of potassium	Newly precipitated oxide of iron with an alkaline carbonate.
Oxalic acid	Chalk, common whiting, or magnesia suspended in water.
Tartar emetic	Tannin, catechu, or other vegetable astringents.
Acetate of lead	Sulphate of magnesia, or the phosphates of soda and magnesia.
Caustic potash or soda	Dilute acetic acid, fixed oils, lemon juice.
Mineral acids	Chalk, common whiting, plaster from the walls or ceiling, or carbonate of magnesia, eggs beaten up.
Chloride of zinc (Burnett's fluid)	Eggs beaten up, milk, carbonate of soda.
Aconite root	Emetic of sulphate of zinc and stimulants.
Belladonna, leaves or root	Emetic of sulphate of zinc, ammonia, stimulants, and after some time an active purgative.
Digitalis (Foxglove)	Emetics, stimulants, and the maintenance of the recumbent position.
Hyoscyamus leaves	Emetics and stimulants.
Opium and all its compounds	Emetics of sulphate of zinc, external stimulation by warmth, turpentine or camphor liniments, enforced exertion, artificial respiration, and small repeated doses of sulphate of atropia.
Chloral hydrate	Same as for opium.
Strychnia or nux vomica	Animal charcoal suspended in water, repeated large doses of chloral hydrate or chloroform.

ANTI-EPILEPTICUM (*Wepler*, Berlin), known as Wepler's Krampfpulver. Magnesia Alba, 5 parts; Rad. Dictamni, 15 parts; Rad. Zedoar, 12 parts; Rad. Artemis, 8 parts; soot, ½ part; Ol. Valerian., ½ part; Ol. Cajeputi, ¼ part.

Dr Hager is the authority for the above, and he adds that formerly the same proprietor sold a remedy which consisted of a black powder made by carbonising hempen thread.

ANTI-FAT. A preparation bearing this name has been largely advertised. It is said to be a fluid extract of *Fucus vesiculosus*, a common seaweed known as sea wrack or bladder wrack. The extract is said to possess remarkable power of removing superabundant fat, this action being attributed to the iodine it contains. Another explanation of its action is, that the gelatinous material envelops the food and protects it from the action of the digestive fluids. See ALGIN.

ANTIFEBRIN. ANTIFEBRINUM. *Syn.* ACETANILIDE, PHENYLACETAMIDE $C_6H_5NH(CH_3CO)$. A coal-tar derivative made by acting on aniline with acetyl chloride or glacial acetic acid.

Colourless crystalline scales melting at 122°—123° C., boiling at 295° C. It dissolves in 194 parts cold water and in 18 parts boiling water, also freely in alcohol, ether, and chloroform. A solution in hot water is reddened by ferric chloride, but cold solutions are not so affected.

Uses. Antipyretic, febrifuge, hypnotic, sedative, nervine tonic. Given in rheumatism, fevers, sick headache, and delirium tremens.—*Dose*, 3 to 15 gr.

ANTIFER'MENT (pop. and more us., in this sense, *an'tiferment'*). [Eng., Fr.] *Syn.* ANTIFERMEN'TUM, L. Any substance which prevents or arrests fermentation. The most modern antiferments are borax, boric acid, and salicylic acid; the two former are frequently mixed and sold under fancy names such as icine and glacialine for the preservation of milk and meat. Salicylic acid is used to preserve beer and many fluids of low alcoholic strength. Chloroform water (1 in 200) is an excellent antiferment. Several nostrums are sold under this name in the cider districts. The following are tried and useful formulæ:

Prep. 1. Sulphite (not sulph*ate*) of lime, in fine powder, 1 part; marble-dust, ground oyster-shells, or chalk, 7 parts; mix, and pack tight so as to exclude the air.

2. Sulphite (not sulph*ate*) of potassa, 1 part; new black-mustard seed (ground in a pepper-mill), 7 parts; mix, and pack so as to perfectly exclude air and moisture.—*Dose* (of either), ½ *oz.* to 1½ *oz.* per *hhd.*

3. Mustard-seed, 14 *lbs.*; cloves and capsicum, of each 1¼ *lb.*; mix, and grind them to powder in a pepper-mill.—*Dose*, ¼ to ½ *lb.* per *hhd.*

Uses, &c. The above formulæ are infinitely superior to those commonly met with in trade; and are quite harmless. A portion of any one of them added to cider, or perry, soon allays fermentation, when excessive, or when it has been renewed. The first formula is preferred when there is a tendency to acidity. The second and third may be advantageously used for wine and beer, as well as for cider. That of the third formula greatly improves the flavour and the apparent strength of the liquor, and also improves its keeping qualities. See CELLAR-MANAGEMENT, FERMENTATION, &c.

ANTIFRICTION GREASE. AXLE-GREASE, FRICTION COMPO', LU'BRICATING COMPOUND, &c. —*Prep.* 1. Good plumbago (black lead), finely powdered and sifted, so as to be perfectly free from grit, is gradually added, through a sieve, to 5 times its weight of good lard contained in an iron pan and rendered semi-fluid, but *not* liquid, by a gentle heat; the mass being vigorously stirred with a strong wooden spatula, after each addition, until the mixture is complete, and the composition smooth and uniform. The heat is then gradually raised until the whole liquefies, when the vessel is removed from the fire to a cool situation, and the stirring, which should have been unremitted, continued until the mixture is quite cold. It is applied in the cold state, with a brush about once a day, according to the velocity of the parts; and is said to be fully three fourths cheaper in use than oil, tallow, tar, or any of the ordinary compo's. When intended for uses in which it will be exposed to warmth, and consequent waste by dripping, a part, or even the whole of the lard is replaced by hard strained grease or tallow, or a little bees'-wax is added during its manufacture.

2. Black lead, 1 part; tallow or grease, 4 parts; ground together until perfectly smooth, either with or without camphor, 3 to 5 *lbs.* per cwt. Expired patent.

3. Scotch soda, 60 *lbs.*; water, 30 *galls.*; dissolve in a capacious boiler, add palm oil and hard tallow, of each 1¼ *cwt.*, and having withdrawn the heat, stir vigorously as before, until the mass is homogeneous and nearly solidified. In hot weather the proportion of tallow is increased, and that of the palm oil diminished; in winter, the reverse. Used for the axles of railway carriages and other coarse purposes. For express trains all tallow is usually employed, irrespective of the weather or season.

4. Melt, but avoid boiling, 16 *lbs.* tallow, and dissolve in it 2¼ *lbs.* of sugar of lead; then add 3 *lbs.* of black antimony. The mixture must be constantly stirred till cold. This composition is for cooling the necks of shafts, and may be of service where the shafts are not of the proper length, or the bearings are at fault.

5. Lard, 2½ *lbs.*; camphor, 1 *oz.*; black lead, ½ *lb.* Rub the camphor in a mortar, into a paste with a small portion of the lard; then add the remainder of the lard and the black lead, and thoroughly mix.

6. (*Railway Grease.*) For summer use, tallow, 1 *cwt.* 3 *qrs.*; palm oil, 1 *cwt.* 1 *qr.* For autumn or spring, tallow, 1 *cwt.* 2 *qrs.*; palm oil 1 *cwt.* 2 *qrs.* For winter, tallow, 1 *cwt.* 1 *qr.*; palm oil, 1 *cwt.* 3 *qrs.* Melt the tallow in a boiler, then add to it the palm oil as soon as the mixture boils, and put out the fire. When the mixture, which should now be frequently stirred, has cooled down to blood heat (98° to 100° F.), it should be run through a sieve into a solution of from 56 to 60 *lbs.* of soda in about 3 *galls.* of water. Thoroughly mix by stirring.

7. Bean or rye flour, 1 *cwt.*; water, 6 *cwt.*; mix to a smooth paste, raise the heat until the mixture boils, and stir in first of milk of lime (of about the consistence of cream), 7 *cwt.*; resin-oil, 10 *cwt.*; and stir vigorously until cold. Inferior.

8. (*Booth's.*) *a.* From Scotch soda, ½ *lb.*; boiling water, 1 *gall.*; palm oil or tallow, or any mixture of them, 10 *lbs.*; as before, observing to continue the stirring until the mixture has cooled down to 60° or 70° F.

b. Soda, ½ *lb.*; water and rape oil, of each 1 *gall.*; tallow or palm oil, ½ *lb.*; as last. Expired patent.

9. (*Mankettrick's.*) From caoutchouc (dissolved in oil of turpentine), 4 *lbs.*; Scotch soda, 10 *lbs.*; glue, 1 *lb.*; (dissolved in) water, 10 *galls.*; oil, 10 *galls.*; thoroughly incorporated by assiduous stirring, adding the caoutchouc last.

10. (LIARD, Fr.) Finest rape oil, 1 *gall.*; caoutchouc (cut small), 3 *oz.*; dissolve with heat.

Uses, &c. To lessen friction in machinery, prevent the bearings rusting, &c. The simplest are perhaps the best. Of late years several different liquid hydrocarbons obtained from coal, and particularly heavy paraffin oil and soft paraffin, have been extensively employed in this way. See FRICTION, LUBRICATION, &c.

ANTI-FRIC'TION METAL. *Prep.* 1. From tin, 16 to 20 parts; antimony, 2 parts; lead, 1 part; fused together, and then blended with copper, 80 parts. Used where there is much friction or high velocity.

2. Zinc, 6 parts; tin, 1 part; copper, 20 parts. Used when the metal is exposed to violent shocks.

3. Lead, 1 part; tin, 2 parts; zinc, 4 parts; copper, 68 parts. Used when the metal is exposed to heat.

4. (*Babbet's.*) Tin, 48 to 50 parts; antimony, 5 parts; copper, 1 part.

5. (*Fenton's.*) Tin with some zinc, and a little copper.

6. (Ordinary.) Tin, or hard pewter, with or without a small portion of antimony or copper. Without the last it is apt to spread out under the weight of heavy machinery. Used for the bearings of locomotive engines, &c.

Obs. These alloys are usually supported by bearings of brass, into which it is poured after they have been tinned, and heated and put to-

gether with an exact model of the axle, or other working piece, plastic clay being previously applied, in the usual manner, as a lute or outer mould. Soft gun-metal is also excellent, and is much used for bearings. They all become less heated in working than the harder metals, and less grease or oil is consequently required when they are used. See ALLOYS, FRICTION, &c.

ANTILITHIC. See LITHONTRYPTICS.

ANTI-MIASMATICUM. A disinfecting powder, manufactured first in Berlin in 1866, and described as 'prepared by steam.' Quicklime slaked with a solution of sulphate of iron and mixed with turf ashes, also probably containing some carbolic acid. Fluid anti-miasticum is a solution of sulphate of iron in impure acetic acid (*Hager*).

ANTIMO″NIAL (-mōne′y-′ăl). Antimon′ial (—Mayne) is a barbarism. [Eng., Fr.] *Syn.* ANTIMONIA′LIS, L. Pertaining to, composed of, or containing antimony. In *medicine* and *pharmacy,* applied to preparations or remedies (ANTIMO″NIALS; ANTIMONIA″LIA, L.) in which antimony, or one of its compounds, is the leading or characteristic ingredient.

ANTIMO′NIATED. *Syn.* ANTIMONIA′TUS, L. Mixed or impregnated with antimony; antimonial.

AN′TIMONY, Sb. At.W. 120; M. Pt. about 425° C. (797° F.); sp. gr. 6·71 to 6·86. *Syn.* METAL′LIC ANTIMONY*, REG′ULUS of A.†; ANTIMO″NIUM, A. METAL′LICUM, STIB′IUM, METAL′LUM ANTIMO″NII†, A. REG′ULUS†, &c., L.; ANTIMOINE, Fr.; ANTIMON, SPIESSGLANZ, SPIESSGLAS, SPIESSGLANZMETALL, Ger.; ANTIMONIO, It., Sp. The term 'antimony' was formerly applied to the native sulphide or greyish-black crystalline ore of antimony; now it is solely appropriated to the pure metal.

Occurrence. Native (seldom), sometimes containing copper, silver, and iron; as arseniferous antimony or allemontite, As_3Sb_2; as double sulphide with the sulphides of lead, copper, &c.; as oxides; in various iron ores, &c. Its chief ore, however, and practically the only one of commercial importance, is the sulphide, Sb_2S_3, commonly called stibnite, antimony glance, antimonite, or grey antimony ore, which is found in large quantity in Cornwall, Hungary, the Harz, Borneo, &c.

Prep. I. On the small scale. Antimony is now but seldom prepared on the small scale, so only three methods for doing this shall be given here:—

(*a*) Two parts of the sulphide in coarse powder are fused together with 1 part of iron filings in a covered crucible, the heat being gradually raised to dull redness.

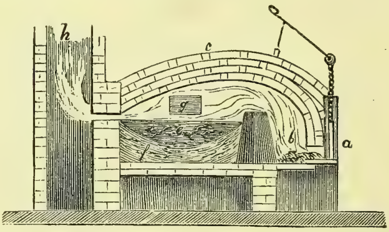
(*b*) (*Wöhler.*) Sulphide of antimony, 10 parts; nitre, 12 parts; dry carbonate of sodium, 15 parts. Deflagrate these together with caution, powder the resulting mass, wash it thoroughly with boiling water, and finally smelt the dried residuum with black flux.

(*c*) From the teroxide, Sb_2O_3, by fusion with twice its weight of crude tartar.

The antimony obtained by any one of these methods is nearly pure, the impurities (if any) being traces of copper, lead, and iron.

II. On the large scale. From the sulphide. This is first freed from gangue by melting it either in vertical cylinders having a hole at the bottom, through which the molten sulphide drops, or in reverberatory furnaces. It is then (*a*) either reduced by fusion with metallic iron, the products being crude antimony and sulphide of iron (this operation is termed 'singling'). To obtain the best 'star antimony' (so called from the stellate appearance of its crystalline surface) from this metal, it must be again melted, in the second process of 'doubling,' with a small quantity of sodium sulphide and slag obtained in the succeeding operation. Finally, it is fused once more with a little pearlash and slag from a previous operation, this being termed 'melting for star metal.' The molten metal is allowed to cool slowly in square moulds, its surface being covered with slag, in order that it may attain the peculiar crystalline structure which is required in commerce. The antimony of commerce is now largely obtained in this way.

Or (*b*) the sulphide is roasted on the hearth of a reverberatory furnace (see fig.), to convert it into



a, b. Grate and fireplace.
c. Bridge.
e. Concave space for ore, resting on a solid bed *f,* formed of sand and clay.
g. Door for introducing the ore, and abstracting residuary slag.
h. Chimney.

oxide. During this roasting care must be taken to stir constantly with an iron spatula, and to regulate and gradually raise the temperature, which should be low until towards the end of the operation, the mass even then only approaching dull redness. Without this precaution much of the sulphide will be lost by volatilisation; the process is complete when the whole mass assumes a greyish-white appearance. The oxide is then reduced to metal by fusing it in an earthenware crucible (in a reverberatory furnace) with 20% of powdered charcoal which has been saturated with concentrated soda, or with 10% of crude tartar. This crude antimony is generally REFINED by smelting it with about 1-8th of its weight of the refined sulphide, and about 1-4th of its weight of carbonate or sulphate of soda; but if there be much iron present, more of the sulphide—even 1-4th—may be required. For, unless there be sufficient sulphur to combine with the whole of the iron, the arsenic will not be oxidised, but will remain as a contamination. When cold, the metal is carefully separated from the slag, and is frequently re-fused with a little fresh carbonate of sodium, after which it is cast into pigs, lumps, or ingots. The crude metal, thus treated, commonly

yields 94% of REFINED METAL of tolerable purity.

Should lead have been present in the sulphide or ore, it remains after a second, or even a third fusion, although proportionately reduced in quantity; and it can only be completely separated in the wet way. It is, therefore, always desirable to select an ore free from lead.

The following paragraph with regard to the purification of antimony is extracted from Roscoe and Schorlemmer's 'Chemistry,' vol. ii, part ii, p. 304:—"Commercial antimony often contains traces of arsenic, iron, lead and copper, and frequently some sulphur. In order to prepare the pure metal, *Liebig's* process is the best. This consists in fusing 16 parts of the metal with 2 parts of sodium carbonate and 1 part of sulphide of antimony for an hour. On cooling the regulus is separated from the slag, and melted again for an hour with 1½ parts of sodium carbonate, and this operation again repeated with 1 part of the same salt. According to *Schiel*, a small quantity of nitre should be added from time to time. By means of this repeated fusion the whole of the arsenic is separated, provided that a sufficient quantity of iron be originally present in the metal; should this not be the case, it is necessary to add about 2% of iron sulphide" (*Bensch*).

To free antimony from iron, it is generally fused with a little antimonic oxide. Most of the antimony of commerce is reduced in England, principally from foreign ores, especially those of Borneo.

Properties, &c. Antimony is a silver-white lustrous brittle metal, with a lamellar texture and a crystalline or granular fracture (according as it has been cooled slowly or quickly); the crystals are octahedrons or dodecahedrons. When pure, the surface shows fern-leaf markings ('star' antimony). Antimony imparts its brittleness to alloys, so little as $\frac{1}{1000}$th part added to gold rendering the latter unfit for the purposes of coinage and the arts. It is unchanged by the air or by water at the ordinary temperature, melts at about 425° C. (just under a red heat), and volatilises at a white heat. When strongly heated in the air it burns to the trioxide, Sb_2O_3, which is deposited in beautiful flowers or crystals. It may, however, be distilled in a current of hydrogen at a white heat. Hot hydrochloric acid dissolves it, with the formation of the trichloride, $SbCl_3$, while concentrated nitric acid converts it into antimonic acid, and dilute into the trioxide, Sb_2O_3.

Applications. Antimony is largely employed in making alloys, the principal of which are type-metal, stereotype metal, music-plate metal, Britannia metal, pewter, &c., which will be referred to individually. It is added to the alloy for concave mirrors, to give them a finer texture; to bell-metal, to render it more sonorous; and to various other metals, to increase their hardness and fusibility. It is much used in alloys with tin, tin and lead, and in some cases copper, for machinery bearings, instead of gun-metal; in cases of rapid and continuous revolution, as in the shafts of screw steamers, these alloys are more enduring than the latter. It is also used for hardening bullets and cannon-balls. Various preparations of antimony, which will be referred to severally, e.g. tartar emetic, are largely employed in medicine.

Phys. Eff., &c. Nearly all the salts and preparations of antimony are depressant, emetic, and cathartic, and in large doses poisonous—occasioning vomiting, profuse alvine dejections, acute colic, and inflammation of the stomach and bowels, often serious, though rarely resulting in death. TARTAR EMETIC and BUTTER OF ANTIMONY are those from which accidents have principally occurred.—*Ant., &c.* Copious vomiting, if it has not already occurred, should be promoted, and freshly prepared hydrated oxide of iron administered in considerable doses, followed or accompanied by mucilaginous drinks and diuretics. If much prostration follows, wine and stimulants may be had recourse to. In the absence of hydrated oxide of iron, a solution of tannin or decoction of galls, cinchona, or oak bark, or even powdered cinchona mixed with tepid water, may be administered.

Tests for Antimony and its Salts. The metal itself may be recognised by its properties, as given above. Its salts show the following reactions: (1) Sulphuretted hydrogen gives: (*a*) with solutions of salts of the trioxide an orange-red precipitate of antimony trisulphide, Sb_2S_3, which is insoluble in dilute acids and only sparingly soluble in ammonia; it readily dissolves, however, in solutions of alkaline sulphides, especially if these contain an excess of sulphur, and also in hot hydrochloric acid with evolution of sulphuretted hydrogen. (*b*) With a solution of antimonic acid in hydrochloric, a precipitate of the pentasulphide, Sb_2S_5, mixed with the trisulphide and sulphur. This precipitate dissolves readily when heated with a solution of soda or ammonia, but only sparingly in one of cold bicarbonate of ammonium.

2. Sulphide of ammonium gives an orange-red precipitate of the trisulphide Sb_2S_3, which readily dissolves in excess of the precipitant; acids throw down the pentasulphide from this solution.

3. Ammonia, potash, and soda, and the carbonates of the last two give with solutions of salts of the trioxide (but *far less completely* with a solution of tartar emetic) a bulky white precipitate of the trioxide itself; those with ammonia and its carbonate are practically insoluble in excess of the precipitant; that with carbonate of sodium soluble on heating; and that with potash and soda readily soluble.

4. A solution of antimony trichloride, which does not contain a very large excess of hydrochloric acid, gives a white precipitate of the oxychloride, SbOCl, upon the addition of water. This readily dissolves in tartaric acid (dif. from bismuth).

5. Metallic zinc throws down metallic antimony as a black powder from all its solutions not containing free nitric acid. If the test be made with a few drops of a solution of antimony containing free hydrochloric acid, either in a platinum dish or in a porcelain one containing a scrap of platinum foil or wire, the portion of platinum covered by the liquid is soon stained brown or black. This reaction is very delicate

and characteristic. Cold hydrochloric acid fails to remove the stain, but warming with nitric acid removes it immediately.

6. Conversion of other antimony compounds into antimoniuretted hydrogen, SbH_3. An exceedingly delicate test. The *modus operandi* here is exactly the same as under *Marsh's* test for arsenic. The latter will be described in detail under ARSENIC, and the differences between antimony and arsenic pointed out there.

Estimation. Antimony is usually weighed in the form of trisulphide, sometimes also as tetroxide, and occasionally as the metal; it may also in certain cases be estimated volumetrically (for which see *Fresenius*' 'Quantitative Analysis').

1. *As Trisulphide,* Sb_2S_3 (100 parts of trisulphide contain 71·77 parts antimony). To the solution containing the antimony some hydrochloric acid (if not already present) is added, then tartaric acid in excess, and, finally, it is largely diluted with water. Sulphuretted hydrogen is now passed through it to saturation, the solution being warmed somewhat, unless there should be a large excess of free nitric or hydrochloric acid present, the object of the warming being to condense the precipitate and so render it easier of filtration. After the liquid is thoroughly saturated (which can only be proved by letting it stand for a few minutes, shaking it, and seeing if it still smells strongly of the gas), the excess of sulphuretted hydrogen is displaced by a current of carbonic acid. The precipitate is then filtered through a *weighed* filter, washed quickly and thoroughly—till free of acid—with water containing a few drops of sulphuretted hydrogen solution, dried at 100° C. and weighed. The dried precipitate always contains traces of water, which can only be completely expelled at a temperature of about 205° C., when it becomes black (See *Fresenius*' 'Quantitative Analysis'). It may also contain free sulphur (*always* when an antimon*ic* compound was originally present). To test this, a small portion of the precipitate is digested with concentrated hydrochloric acid, in which it will dissolve completely if no free sulphur is present. Should part of the precipitate remain insoluble, a weighed portion of it must be oxidised by fuming nitric and a little strong hydrochloric acid till the whole is dissolved; the solution must then be diluted with water and excess of tartaric acid, and the sulphuric acid precipitated by barium chloride in the usual way (see SULPHURIC ACID, DETERMINATION OF). 233 parts by weight of barium sulphate ($BaSO_4$) are equivalent to 32 parts by weight of sulphur (S). The amount of sulphur thus found is then deducted from that of the precipitate taken, the remainder being antimony.

2. As tetroxide, Sb_2O_4 (which contains 79·22% of its weight of antimony). The quantity of PURE ANTIMONY in commercial samples may be determined with fair accuracy by treating them (in powder) with strong nitric acid, which oxidises the antimony and leaves it in an insoluble state, whilst it dissolves the other metals. This oxidation must be done very cautiously, the nitric acid being added drop by drop to the antimony in a flask; otherwise the reaction is very violent. The resulting oxide is collected on a filter, washed, dried, ignited in an open porcelain crucible, and weighed.

3. As metallic antimony. Dissolve a known weight of the sample in hydrochloric acid, immerse a blade of pure metallic tin in the solution, and keep the liquor acid and in a state of gentle ebullition by the heat of a sand-bath, when the whole of the ANTIMONY will be precipitated as a black powder, and may be collected, washed, dried, and weighed. This method is particularly adapted to alloys of antimony and tin.

Impurities in Commercial Antimony. The antimony of commerce generally contains a little arsenic, with variable quantities of iron, lead, sulphur, and tin. These impurities may be detected as follows:

1. (Arsenic.) By fusing the sample, in powder, mixed with about an equal weight of tartrate or bitartrate of potassium, in a covered crucible, for 2 or 3 hours, and placing the resulting button (which is an alloy of antimony and potassium) in a 'Marsh's apparatus' along with a little water, when the disengagement of hydrogen gas will commence; this may then be tested for arseniuretted hydrogen in the usual manner. See ARSENIC.

2. (Iron.) Dissolve the powdered sample in nitro-hydrochloric acid, dilute the solution with a large quantity of cold water, filter, and pass a current of sulphuretted hydrogen through the filtrate as long as it produces a precipitate; again filter, boil the filtrate for a few minutes to drive off the excess of sulphuretted hydrogen, and then test it with ferrocyanide of potassium, which will give a blue precipitate if iron be present; or supersaturate the last filtrate with ammonia, and then add ammonium sulphide, when, under like conditions, a black precipitate of ferrous sulphide will be formed. See IRON, DETECTION AND ESTIMATION OF.

3. (Lead.) Digest the powdered sample in hot nitric acid, which will dissolve out the lead but leave the antimony behind. After evaporating the mixture nearly to dryness, taking up with water, and filtering from the antimony oxide, the filtrate is tested for lead by the usual reagents; or, if desired, the latter can be estimated quantitatively as sulphate. See LEAD, DETECTION AND ESTIMATION OF.

4. (Sulphur.) *a.* The powdered metal, when heated with strong hydrochloric acid, gives off sulphuretted hydrogen. *b.* The sulphur may both be detected and estimated as barium sulphate, by oxidising a weighed quantity of the powdered metal with fuming nitric and a little strong hydrochloric acid, exactly as given under the determination of antimony as sulphide.

5. (Tin.) Two samples of equal weight are taken. In the one the antimony is determined by precipitation with tin, as described above. The other is dissolved in a mixture of equal parts of hydrochloric and nitro-hydrochloric acids, and a blade of zinc immersed in the solution (see *above*); the mixed precipitate of tin and antimony which forms is collected on a weighed filter, washed, dried, and weighed. The weight of antimony in the first sample, subtracted from that now obtained, gives the quantity of TIN in the original sample.

Antimony, Chlorides of.

Antimony Trichloride, $SbCl_3$. *Syn.* TERCHLORIDE OF ANTIMONY, ANTIMONIOUS CHLORIDE, CHLO′′RIDE OF ANTIMONY, SESQUICHLORIDE OF A., BUTTER OF A., CAU′STIC ANTIMONY†, &c.; ANTIMO′′NII CHLORI′DUM, A. TERCHLORI′DUM, A. BU′TYRUM*, &c., L.; CHLORURE D'ANTIMOINE, BEURRE D'ANTIMOINE, &c., Fr.; ANTIMONCHLORID, SPIESSGLANZ-BUTTER, Ger. This is the substance of which the common chloride, or butter of antimony, of the shops is composed; it is an impure concentrated solution containing free acid.

Prep. 1. Solid, anhydrous:

a. One part pure commercial tersulphide of antimony, Sb_2S_3, in coarse powder, and 5 parts concentrated hydrochloric acid are mixed together in a capacious stoneware or glass vessel set under a chimney with a quick draught, to convey away the fumes, the whole being constantly stirred, and, as the effervescence slackens, a gradually increasing gentle heat applied until solution is complete. The resulting liquid is then transferred to a retort and distilled, until each drop of the distillate, as it falls into the aqueous liquid which has previously passed over into the receiver, produces a copious white precipitate; the receiver is then changed, and the distillation continued, when pure TRICHLORIDE OF ANTIMONY passes over, and solidifies on cooling to a white and highly crystalline mass, which must be carefully kept from the moisture of the air.

b. Two parts pure metallic antimony, and 5 parts bichloride of mercury, both in fine powder, are mixed together and distilled from a retort with a wide neck into a suitable receiver, the retort being carefully heated on a sand-bath. The resulting product should be chemically pure.

2. Liquid:

a. (LIQUOR ANTIMONII CHLORIDI, B. P.) *Syn.* SOLUTION OF CHLORIDE OF ANTIMONY.

Prep. Four pints of hydrochloric acid are poured over 1 lb. of black antimony in a porcelain vessel, under constant stirring, and the resulting mixture is gradually heated, as the evolution of gas slackens, up to boiling, underneath a flue with a good draught. It is boiled for fifteen minutes, and then filtered through calico till clear (the first portion must be passed through a second time). The filtrate is boiled down to a volume of two pints, and preserved in a stoppered bottle. The sp. gr. of this solution is 1·47. One fluid drachm of it mixed with a solution of a quarter of an ounce of tartaric acid in four fluid ounces of water forms a clear solution, which, if treated with sulphuretted hydrogen, gives an orange precipitate of sulphide, weighing, when washed and dried at 212° F. (100° C.), at least 22 grains.

b. (Commercial.) *α.* Take of ash or calx of antimony, $3\frac{1}{4}$ *lbs.*; common salt, 2 *lbs.*; oil of vitriol, $1\frac{1}{2}$ *lbs.*; water, 1 *lb.*; proceed as before. *Prod.*, $2\frac{1}{2}$ *lbs.*

c. From roasted sulphide or glass of antimony, 7 *lbs.*; salt, 28 *lbs.*; oil of vitriol, 21 *lbs.*; water, 14 *lbs.*; as before.

d. From crude sulphide of antimony (powdered), 25 *lbs.*; strongest commercial hydrochloric acid, 1 *cwt.*; nitric acid, $3\frac{1}{2}$ *lbs.*; as before. The product, after colouring with a little ferric nitrate, is made up to a sp. gr. of 1·4. The quality is improved, and the process more easily conducted, if the crude antimony sulphide is roasted before dissolving it in the acid. The same applies to the other methods given.

Props. and Tests for. Pure anhydrous trichloride of antimony is a white deliquescent crystalline mass, which rapidly absorbs moisture from the air, becoming an oily liquid thereby. When pure, and nearly free from water, it somewhat resembles butter (hence the name 'butter of antimony'); it melts at a gentle heat, and partially crystallises on cooling. The sp. gr. of the solution of the shops varies from 1·25 to 1·4. The trichloride reacts with water to form the oxychloride, SbOCl, and free hydrochloric acid, thus: $SbCl_3 + H_2O = SbOCl + 2HCl$. This basic white chloride can be at once distinguished from the similar white oxychloride of bismuth, BiOCl, by (*a*) its solubility in tartaric acid; (*b*) its conversion into the orange-coloured sulphide by sulphuretted hydrogen (sulphide of bismuth being black).

Phys. Eff., Ant., Lesions, &c. See ANTIMONY.

Uses. In *medicine*, only externally, and chiefly as a caustic or escharotic to the wounds caused by rabid and venomous animals, and to repress excessive granulations in ulcers. In *pharmacy*, as a source of both oxychloride and oxide of antimony.

Antimony Oxychloride, SbOCl. *Syn.* POWDER OF ALGAROTH. Thrown down as a white precipitate when trichloride of antimony is poured into water. Continued washing with water deprives it of nearly the whole of its chlorine, and converts it into the trioxide, a change which is more completely effected by aqueous solutions of the alkalies or their carbonates.

2. **Antimony Pentachloride**, $SbCl_5$. *Syn.* PERCHLO′′RIDE OF ANTIMONY; ANTIMO′′NII PENTACHLORI′DUM, L. This is readily prepared, either by saturating the fused trichloride with chlorine gas, or by passing a current of the latter over gently-heated metallic antimony in fine powder. In the latter case a mixture of the trichloride and pentachloride is found in the receiver; they can be separated by careful distillation. Antimony pentachloride is a colourless, fuming liquid, of disagreeable odour, readily volatile, and decomposing partially into the trichloride and chlorine when distilled. It forms the crystalline compound, $SbCl_5 + 4H_2O$, with a small quantity of water, but is decomposed by a larger quantity into the white oxychloride, SbO_2Cl, which is converted by hot water into antimonic acid. When mixed at once with a large excess of water, the liquid remains clear; tartaric acid and an excess of hydrochloric acid likewise prevent this precipitation by water.

Oxides and Oxy-acids of, and Salts of the latter. Antimony forms three oxides, viz.: Antimonious oxide, Sb_4O_6; antimony tetroxide, Sb_2O_4; antimony pentoxide, Sb_2O_5.

Antimonious Oxide, Sb_4O_6. *Syn.* TRIOXIDE or TEROXIDE OF ANTIMONY (B.P. OXIDE OF ANTIMONY, Eng.; ANTIMONII OXIDUM, L.). This

oxide is found in nature as the mineral valentinite, along with other ores of antimony, from the oxidation of which it has been produced.

Prep. The directions for its preparation are given in the B.P. as follows: Take of solution of chloride of antimony, 16 *fl. oz.;* carbonate of sodium, 6 *oz.;* water, 2 *galls.;* distilled water, a sufficiency. Pour the antimonial solution into the water, mix thoroughly, let the precipitate settle, remove the supernatant liquid by a siphon, add 1 gall. of distilled water, agitate well, let the precipitate subside, again withdraw the fluid, and repeat the processes of affusion of distilled water, agitation and subsidence. Add now the carbonate of sodium previously dissolved in 2 pints of distilled water, leave them in contact for half an hour, stirring frequently; collect the deposit on a calico filter, and wash with boiling distilled water until the washings cease to give a precipitate with a solution of nitrate of silver acidulated by nitric acid. Lastly, dry the product at a temperature not exceeding 100° C. (212° F.).

Char. and Tests. A greyish-white powder, fusible at a low red heat, insoluble in water, but readily dissolved by hydrochloric acid, to a solution of the trichloride, $SbCl_3$. This solution, dropped into distilled water, gives a white deposit of oxychloride, which is at once changed to the orange-coloured sulphide by sulphuretted hydrogen. It dissolves entirely when boiled with an excess of the acid tartrate of potassium.

Uses. It may be used for the same purposes as tartar emetic, but as it is insoluble in water, it depends upon the acidity of the stomach how much will be dissolved. This character makes it uncertain in its action, so that tartar emetic is usually preferred. It is commonly given in the form of Pulvis Antimonialis, or James's powder. Therapeutically it is an antipyretic, used in fever and rheumatism, also in chronic skin diseases, combined with mercury.—*Dose,* 1 to 4 gr.

The hydrated acid corresponding to the above oxide, ANTIMONIOUS ACID, $2HSbO_2+3H_2O$, and its salts, the ANTIMONITES, are of no practical importance.

Antimony, Tetroxide of. Sb_2O_4 or $Sb_2O_3Sb_2O_5$. *Syn.* ANTIMONOSO-ANTIMONIC OXIDE. Molecular weight unknown. Found native as Cervantite or Antimony ochre. Prepared by heating antimonic anhydride, by roasting the trioxide or trisulphide, or by the action of excess of nitric acid on finely powdered metallic antimony. Thus prepared, it is a white solid, unalterable by heat; slightly soluble in water, more so in hydrochloric acid.

We are not acquainted with a hydrated acid of this oxide; and of the salts corresponding to the latter (*e. g.* K_2O,SbO_4) but little is known.

Antimonic Oxide, Sb_2O_5. *Syn.* ANTIMONIC ANHYDRIDE, ANHYDROUS ANTIMONIC ACID, PENTOXIDE OF ANTIMONY. Molecular weight unknown. Antimonic and metantimonic acids lose water when heated to a temperature below redness, and yield the anhydride Sb_2O_5. This is a heavy yellowish-white powder, tasteless and insoluble in water and nitric acid, but soluble—though with difficulty—in concentrated hydrochloric acid, and readily in a solution of caustic potash. If fused with carbonate of potash, carbonic anhydride is expelled, and a salt is produced from which antimonic acid is precipitated by acids.

This oxide gives rise to three hydrates, viz. Sb_2O_5,H_2O or $HSbO_2$, antimonic acid; $Sb_2O_5,2H_2O$ or $H_4Sb_2O_7$, metantimonic acid, and $Sb_2O_5,3H_2O$ or H_3SbO_4. Of the last but little is known.

Antimonic Acid, $HSbO_3+2H_2O$. *Syn.* ACIDUM ANTIMONICUM, L.; ACIDE ANTIMONIQUE, Fr.; ANTIMONSÄURE, Ger.

Prep. 1. By decomposing one of its salts with sulphuric or nitric acid.

2. Pure metallic antimony, in coarse powder or small fragments, is digested in excess of concentrated nitric acid until the oxidation and conversion is complete; the excess of nitric acid is then removed by evaporation nearly to dryness, and the residuum throw into cold distilled water, after which the powder (ANTIMONIC ACID) is collected on a calico filter, washed with distilled water, and dried at a gentle heat. Pure.

Prop. Antimonic acid is a soft white powder, sparingly soluble in water, which reddens litmus, and is dissolved, even in the cold, by strong hydrochloric acid and by potash. It becomes anhydrous on gentle ignition. The hydrochloric solution, mixed with a small quantity of water, yields, after a while, a precipitate of antimonic acid; but if diluted with a large quantity of water, it remains clear. Ammonia does not dissolve it in the cold. By heating with a large excess of caustic potash, it is converted into metantimonic acid. It was formerly known under the name of *materia perlata,* and was employed as a medicine.

The salts of antimonic acid are termed *antimonates.* Potassium antimonate, $KSbO_3$, is obtained by deflagrating one part of metallic antimony with four parts of saltpetre and lixiviating with warm water, when a white powder remains which is very insoluble in water unless boiled with the latter. "The salt $4KSbO_3+2HSbO_3+9H_2O$ was probably known to Basil Valentine" (who lived in the second half of the fifteenth century, and who was the first to investigate antimony compounds), "and was much employed by quack doctors and known as *antimonium diaphoreticum ablutum*" (*Roscoe* and *Schorlemmer,* vol. ii, part 2).

Antimony, Diaphoret'ic. *Syn.* CALX OF ANTIMONY, CALCINED' A., ANTIMO''NIATE OF POT'ASH, STIB'IATED KA'LI†, DIAPHORETIC MIN'ERAL†, &c.; ANTIMO''NIUM DIAPHORET'ICUM, A. CALCINA'TUM, CALX ANTIMO''NII, C. A. ANGLO''RUM†, POTAS'SÆ ANTIMO''NIAS, KALI STIB'ICUM†, &c., L. var.; ANTIMOINE DIAPHORÉTIQUE, BIANTIMONIATE DE POTASSE, Fr. An old preparation with numerous synonyms, of which the first two of the above are those now chiefly in use.

Prep. 1. Sulphide of antimony, 1 part; nitre, 3 parts; powder, mix, and deflagrate by spoonfuls in a red-hot crucible, then calcine for half an hour, and when cold powder the residuum.

2. WASHED DIAPHORETIC A., W. CALX OF A.; ANTIMONIUM DIAPHORETICUM LO'TUM, A. D. ABLU'TUM (Ph. Bor. 1847), A. CALCINA'TUM (Ph. L. 1788); ANTIMOINE DIAPHORÉTIQUE LAVÉ, &c., Fr.:—*a.* (Ph. L. 1788.) As the last, but the powder is subsequently deprived of soluble matter

by repeated washings with water, after which it is collected and dried.

Prop., &c. A white or greyish-white powder, without either smell or taste; gently diaphoretic and laxative, its activity greatly depending on the quantity of acid in the stomach.—*Dose,* 1 to 6 gr., or even 10 gr.; for *horses,* 1 to 3 or 4 *dr.* It was formerly in high repute, but is now almost superseded by the present pharmacopœial preparations.

Metantimonic Acid, $H_4Sb_2O_7 + 2H_2O$. *Prep.* (1) By decomposing antimony pentachloride, $SbCl_5$, with water. (2) 1 part metallic antimony in powder and 6 to 8 parts of powdered nitre are mixed together, and ignited or deflagrated in a silver crucible. The resulting mass, when cold, is powdered, the excess of alkali washed out with hot water, and the residue (metantimoniate of potassium) decomposed by hydrochloric acid; lastly, the precipitate of metantimonic acid is washed and dried.

Props. The air-dried precipitate has the formula given above, but it yields up its water at 100°. It is rather more soluble in water than antimonic acid, and dissolves more readily in acids than the latter; soluble also in ammonia. From its solution in a large quantity of water it is precipitated by acids. It is very unstable, being converted into antimonic acid either at 200° or when kept under water. Among the metantimoniates, mention may be made of the *acid sodium metantimoniate,* $H_2Na_2Sb_2O_7 + 6H_2O$, which is remarkable as being the only insoluble salt of sodium; it is quite insoluble in cold, and only sparingly soluble in hot water. It is precipitated gradually on adding a solution of potassium metantimoniate to a solution of a sodium salt, this reaction being made use of for the detection of sodium.

Antimony, Sulphides of:

Antimony, Trisulphide, Sb_2S_3. *Syn.* Tersul'phide of antimony, Sul'phide of a., Sul'phuret of a., Black s. of a., Sesquisul'phuret of a., &c.; L'antimoine sulfuré, Sulfure d'antimoine, &c., Fr.; Schwefelspiessglanz, Anderthalb, &c., Ger. This is the grey or greyish-black substance commonly known in commerce as crude antimony, black antimony, or sulphide of antimony, and from which the other compounds of antimony are chiefly obtained. See Antimony.

Its separation from the gangue of the ore by fusion has been already described. After remelting, it is run into 'loaves' or large cakes, in which form it is sent to market. Native trisulphide of antimony treated in this way and ground to powder constitutes the black antimony (Antimonium nigrum) of the British Pharmacopœia. The orange-coloured hydrated sulphide is readily prepared by saturating an aqueous solution of tartar emetic or an acid solution of the trichloride with sulphuretted hydrogen, and filtering, washing, and drying the precipitate. When dried at 200° C., it becomes anhydrous and black. The mineral *kermes* or *alkermes,* which played such an important *rôle* as a medicine in the last century was the amorphous brown-red trisulphide of antimony containing some trioxide.

Props., &c. Native trisulphide of antimony or stibnite has a dark leaden-grey to steel-grey colour and a metallic lustre, and is tasteless, inodorous, opaque, brittle, and easily powdered. It has a striated crystalline texture, and breaks with a rough spicular fracture; is insoluble in water and alcohol, but soluble in solutions of alkalies and (with decomposition) in hot strong acids. It melts at a red heat, and is partly dissipated in white fumes, leaving an impure grey-coloured oxide mixed with some undecomposed tersulphide (antimony-ash). Its powder is black, of peculiar richness, and stains the fingers. Sp. gr. 4·6 to 4·62. The crude commercial sulphide frequently contains lead, iron, copper, and arsenic, and sometimes manganese. Its goodness is commonly estimated by its compactness and weight, the largeness and distinctness of the striæ, and the volatility of its sulphide. To purify it from arsenic, the B.P. directs that 1 lb. of the sulphide in fine powder shall be macerated in 8 fl. oz. of solution of ammonia for five days, with frequent stirring. The powder is then allowed to subside, the supernatant liquid poured off, and the residue washed with water and dried by the aid of heat.

Uses, &c. Chiefly as a source of metallic antimony, and of the oxide in the preparation of other antimonials. Exhibited alone, it possesses little activity unless it meets with acid in the *primæ viæ,* when it occasionally acts with considerable violence both as an emetic and cathartic. —*Dose,* 10 to 30 gr., in powder. Rarely used in regular medical practice. Acts as an alterative and diaphoretic in rheumatism, gout, scrofula, and glandular affections, and in lepra, scabies, and some other skin diseases. It is a favourite alterative in *veterinary medicine,* particularly in skin diseases. Farriers and grooms frequently mix a little of it with the food of horses to improve their coat and promote their 'condition.'—*Dose.* For a horse, 1 to 4 *dr.,* in fine powder, often combined with nitre and sulphur; for cattle, ½ to 1 *oz.,* or even 1½ *oz.;* for dogs, 5 or 6 to 20 or 30 gr.; for hogs, 20 to 30 gr. twice or thrice daily. According to Dr Paris, it is one of the ingredients in Spilsbury's Drops. It is also an ingredient in Tisane de Feltz.

The Thio-antimonites (sulph-antimonites), or **Livers of Antimony.** Just as antimony trioxide dissolves in alkalies to form antimonites, so does the trisulphide dissolve in alkaline sulphides to form thio-antimonites, thus:

$$Sb_2S_3 + K_2S = \underbrace{2KSbS_2}_{\text{Potass. thio-antimonite.}}$$

They are also obtained, together with antimonite, when the trisulphide is fused with an alkali or alkaline carbonate, thus:

$$2Sb_2S_3 + 4KOH = 3KSbS_2 + KSbO_2 + H_2O.$$

Their solutions rapidly absorb oxygen from the air, and acids reprecipitate from them the trisulphide:

$$2KSbS_2 + 2HCl = Sb_2S_3 + 2KCl + H_2S.$$

Some of the thio-antimonites are found native as minerals, *e.g.* Zinkenite, PbS,Sb_2S_3; antimonial copper glance, Cu_2S,Sb_2S_3, &c., &c.

Antimony Oxysulphide, $Sb_2O_3,2Sb_2S_3$, is found

native, along with stibnite as the mineral red antimony, antimony blende, or kermesite. The preparation known as *glass of antimony,* or *vitrum antimonii,* is obtained by fusing oxidised stibnite with a small quantity of the sulphide. It forms a dark ruby-red mass, and is now only used for imparting a yellow tint to glass and porcelain.

Various other oxysulphides of antimony can be prepared artificially. They were formerly much used in pharmacy for the preparation of tartar emetic, but are now nearly obsolete. Among them may be mentioned:

Antimony Pentasulphide, Sb_2S_5, does not occur native. It is now prepared by dissolving the well-crystallised sodium thio-antimonate, or *Schlippe's salt,* $Na_3SbS_4 + 9H_2O$, in 10 to 60 parts of cold water, and gradually adding a cold mixture of 3·3 parts sulphuric acid and 100 parts water. The precipitate is then well washed with water, and dried at a moderate temperature in the dark. Antimony pentasulphide is a yellowish-red powder, insoluble in water, but readily soluble in aqueous alkalies and their sulphides; also (in absence of air) in warm ammonia. Hydrochloric acid decomposes it into trichloride of antimony, sulphur, and sulphuretted hydrogen.

Thio-antimonates (or **Sulph-antimonates**). These salts stand in the same relation to antimony pentasulphide as the thio-antimonites do to the trisulphide; they are analogous to the antimonates, only containing sulphur in place of oxygen.

Sodium Thio-antimonate, $Na_3SbS_4 + 9H_2O$. *Syn.* SCHLIPPE'S ANTIMONIAL SALT. *Prep.* Mix 8 parts of anhydrous sodium sulphate (Na_2SO_4) with 6 of black antimony and 3 of charcoal, and heat the mixture in a covered Hessian crucible until the fused mass ceases to throw up a scum. Boil the product in a porcelain basin with one part of sulphur and a sufficiency of distilled water, and set the filtered liquor aside for crystallisation. The salt crystallises in large colourless or yellow tetrahedrons.

The following antimony preparations, being difficult to classify properly, are now given in alphabetical order:

Antimony, Ash of. *Syn.* ANTIMONY-ASH, CALCINED' ANTIMONY*; CI'NIS ANTIMO''NII, ANTIMO''NIUM CALCINA'TUM*, L. Prepared by roasting the common grey sulphide of antimony on an iron plate set under a chimney to carry off the fumes. The product is a mixture of teroxide of antimony with some unburnt sulphide, and a little antimonious acid.

Prop., &c. Ash-grey; emetic in small doses. Used chiefly as a cheap substitute for teroxide of antimony by the manufacturers of tartar emetic; also to make metallic antimony.

Antimony, Butt'er of. See ANTIMONY, TRICHLORIDE OF.

Antimony, Ce'ruse of. *Syn.* ANTIMO''NII CERUS'SA, L. *Prep.* (*Bate*). The same as that of diaphoretic antimony (over which it possesses no advantage), only using the metal in this case instead of the sulphide.

An old preparation made by igniting antimony in the sun's rays, by means of a lens, was called ANTIMONII CERUSSA SOLA'RIS.

Antimony, Cro'cus of. *Syn.* SAFF'RON OF ANTIMONY, LIV'ER OF A.; CRO'CUS ANTIMO''NII, C. METALLO''RUM, HE'PAR ANTIMONII, L.; CROCUS D'ANTIMOINE, SAFFRAN D'A., Fr. *Prep.* 1. From equal parts of black sulphide of antimony and saltpetre, deflagrated together by small portions at a time, the fused mass (separated from the scoriæ) being reduced to fine powder.

2. (ANT. CROCUS, Ph. L. 1788.) Sulphide of antimony, 1 lb.; nitre, 1 lb.; common salt, 1 oz.; as before.

Prop., &c. Its medicinal properties closely resemble those of diaphoretic antimony. It is a mixture of sulphate of potassium, antimoniate of potassium, teroxide of antimony, oxysulphide of antimony, sulphide of potassium, and undecomposed trisulphide of antimony, in variable and undetermined proportions. When repeatedly washed or boiled in water and dried, it forms the WASHED SAFFRON OF ANTIMONY (C. A. LO'TUS, L.) of old pharmacy, and has then lost its sulphate of potassium, caustic potash, and sulphide of potassium.

Antimony, Crude. Native sulphide of antimony melted from the gangue.

Antimony, E'thiops of. *Syn.* ÆTHIOPS ANTIMONIA'LIS, L. *Prep.* 1. From metallic mercury, 1 part; sulphide of antimony, 2 parts; triturated together until the globules of the former entirely disappear.—2. Sulphide of antimony, 3 parts; black sulphide of mercury, 2 parts; triturated together for some time. An old remedy in certain skin diseases, still highly esteemed by some provincial practitioners.—*Dose,* 3 to 5 gr., gradually increased to 20 or 30 gr.

Antimony, Flow'ers of. *Syn.* FLO''RES ANTIMO''NII, L.; FLEURS D'ANTIMOINE, Fr. *Prep.* Throw powdered sulphide of antimony, by spoonfuls at a time, into an ignited tubulated retort with a short and very wide neck, until as many 'flowers' collect in the receiver as are required. An impure oxysulphide of antimony, with variable portions of trioxide, and undecomposed tersulphide. Emetic in doses of 1 to 3 grains.

Antimony, Flowers of (Ar'gentine). *Syn.* WHITE OX'IDE OF ANTIMONY, SNOW OF A.†; ANTIMO''NII FLO''RES ARGENTI'NI, A. NIX†, L.; FLEURS ARGENTINE D'ANTIMOINE, OXYDE BLANC D'ANTIMOINE, Fr. *Prep.* Melt metallic antimony in a vessel freely exposed to the air, and with a sufficient condensing surface, and collect the 'flowers' as they are deposited; or, what is better, heat the metal to a full red or white heat in a covered crucible, and then suddenly expose it to the air, when it will inflame, and the oxidised vapour condense as 'flowers' on any cool surface (*e. g.* a partially inverted wide-mouthed flask) held at a little distance over it. The product is TRIOXIDE OF ANTIMONY in a crystalline form, which received the name of argentine flowers from its silvery whiteness and beauty.

Antimony, Flowers of (Helmont's). *Syn.* FLO''RES ANTIMO''NII HELMON'TII. An old preparation formed by dissolving sulphide of antimony in aqua regia, expelling the free water and acid by heat, and subliming the residuum with an equal weight of sal ammoniac. Violently emetic, even in small doses, and unfit for internal use.

Antimony, Ful'minating. See FULMINATING COMPOUNDS.

Antimony, Glass of. *Syn.* VIT'RIFIED ANTIMONY*, V. OX'IDE OF A.*, GREY O. OF A.*; ANTIMO"NII VIT'RUM, ANTIMO"NIUM VITRIFICA'TUM, A. VITRIFAC'TUM (Ph. L. 1788), OX'YDUM ANTIMONII VITRIFICATUM, &c., L.; VERRE D'ANTIMOINE, OXYSULFURE D'ANTIMOINE SILICATÉ, Fr. *Prep.* (Ph. L. 1788). Roast sulphide of antimony in a shallow earthen vessel over a moderate fire, stirring it constantly with an iron rod until it turns whitish-grey and ceases to emit fumes at a red heat; put the residuum into a covered crucible so as to fill the latter only two thirds, and expose it to an intense heat (gradually raised) until it fuses, then pour it out on an iron plate. Should the calcination have gone too far, a little more crude antimony may be added to make it run well.

Comp., Prop., &c. A mixture of sulphide and oxide of antimony contaminated with a little silica and iron. In fine powder it is emetic, in doses of 1 to 3 gr.; but owing to the uncertainty and violence of its operation, it is now seldom employed. It has been used as a cheap source of the TEROXIDE by the manufacturers of tartar emetic.

Antimony, Li'ver of. *Syn.* HE'PAR ANTIMO"NII, L.; HÉPAR D'ANTIMOINE, OXYSULFURE D'ANTIMOINE SILICATÉ, Fr. *Prep.* From sulphide of antimony, 1 part; and dry carbonate of sodium or potassium, 2 parts; melted together, and heated until the product acquires the proper colour, when it is cooled and powdered.

Comp., Uses, &c. A mixture of trioxide of antimony, sulphide of potassium, carbonate of potassium, and undecomposed trisulphide of antimony. It is chiefly used by farriers, in doses of 1 to 2 dr., as an alterative purge for horses, in greasy heels, &c.; and sometimes by chemists, as a source of the crude oxide. Crocus of antimony, before noticed, sometimes passes under the name, and is sold for it.

Antimony, Ru'by of. *Syn.* MEDIC'INAL REG'ULUS OF ANTIMONY; ANTIMO"NII RUBI'NUS, REG'ULUS MEDICINA'LIS, R. A. M., &c., L. From crude sulphide of antimony, 5 parts; fused with carbonate of potassa, 1 part; and the purified portion separated from the scoriæ. See LIVER OF ANTIMONY.

Antimony, Saff'ron of. See CROCUS OF ANTIMONY.

Antimony, Snow of. See ANTIMONY, FLOWERS OF.

Antimony, Sulphurated (B.P.) *Syn.* OXYSULPHURET OF PRECIPITATED SULPHIDE OF ANTIMONY, GOLDEN SULPHIDE OF ANTIMONY. Mix 10 *oz.* of black antimony and 10 *oz.* of sublimed sulphur with 4½ pints of solution of soda, and boil for two hours, with frequent stirring, adding distilled water occasionally to maintain the same volume of liquid. Strain the liquor through calico, and, before it cools, add to it by degrees dilute sulphuric acid till the latter is in slight excess. Collect the precipitate on a calico filter, wash with distilled water till the washings no longer yield a precipitate with chloride of barium, and dry at a temperature not exceeding 212° F. (100° C.).—*Dose*, 1 to 5 gr.

This compound is a mixture of pentasulphide of antimony (Sb_2S_5) with a little oxide (Sb_2O_3 or Sb_2O_5). It is one of the many varieties of *kermes mineral*, so called because its orange-red colour is similar to that of the insect once known as *kermes*.

Antimony, Tartarated $(KSbOC_4H_4O_6)_2H_2O$. *Syn.* TARTARISED ANTIMONY, TARTAR EMETIC, EMETIC TARTAR, POTASSIO-TARTRATE OF ANTIMONY, Eng.; ANTIMONIUM TARTARATUM, B.P. *Prep.* Various methods have been devised for the preparation of this compound, but the following, which is taken from the British Pharmacopœia, is to be preferred:

Take of oxide of antimony, 5 *oz.*; acid tartrate of potash in fine powder, 6 *oz.*; distilled water, 2 pints. Mix the oxide of antimony and acid tartrate of potash with sufficient distilled water to form a paste, and set aside for 24 hours. Then add the remainder of the water, and boil for a quarter of an hour, stirring frequently. Filter, and set aside the clear filtrate to crystallise. Pour off the mother-liquor, evaporate to one-third, and set aside, that more crystals may form. Dry the crystals on filtering paper at the temperature of the air.

Char. and Tests. In colourless transparent crystals exhibiting triangular facets, soluble in water, and less so in proof spirit. It decrepitates and blackens upon the application of heat. Its solution in water gives with hydrochloric acid a white precipitate, soluble in excess, and which is not formed if tartaric acid be previously added. Twenty-nine grains dissolve without residue in a fluid ounce of distilled water at 60° F. (15·5° C.), and the solution gives with sulphuretted hydrogen an orange precipitate which, when washed and dried at 212° F. (100° C.), weighs 15·1 grains.

Dunstan and Boole find that owing to efflorescence the commercial salt is wanting in uniformity. They advise the anhydrous salt should be used. It is made by adding to a strong watery solution of tartar emetic a large volume of alcohol, which precipitates the salt.

Phys. Eff., Doses, &c. Externally tartar emetic acts as a powerful local irritant, causing a pustular eruption, which permanently marks the skin; for this purpose it is used in the form of solution, ointment, or plaster. Internally, in small doses ($\frac{1}{16}$ to $\frac{1}{8}$, or even $\frac{1}{6}$ gr.), it acts as a diaphoretic and expectorant; in somewhat larger doses ($\frac{1}{6}$ to $\frac{1}{2}$ gr.) it excites nausea, and sometimes vomiting, occasioning depression and relaxation, especially of the muscular fibre; in larger doses (1 to 2 or 3 gr.) it acts as an emetic and sudorific (and often as a purge), depressing the nervous functions and producing a sense of feebleness, exhaustion, and relaxation greater than that caused by other emetics; in certain doses ($\frac{1}{2}$ to 3, or even 4 gr.) it is used as a sedative and antiphlogistic, to reduce the force o the circulation, &c.; in excessive doses it acts as an irritant poison, and has in some instances caused death; and even small doses, frequently administered and long continued, have brought on a state of weakness, prostration, and distaste for food which has led to a fatal termination. It is usually exhibited dissolved in distilled water, either with or without the addition of a little

simple syrup. In acute rheumatism, inflammation of the lungs or pleura, chorea, hydrocephalus, and apoplexy, it is said to have been given in doses of 2 to 4, or even 6 gr. with advantage, by Laennec, Rasori, and others; but these extreme doses are not always safe, and cannot be commendable when smaller ones ($\frac{1}{4}$ to $\frac{1}{2}$ gr., repeated every 2 hours) appear equally beneficial, and distress the patient less. "In consequence of the violent vomiting" (and it might be added—prostration) "which (even) 1 gr. has sometimes produced, I have found patients positively refuse to continue the use of the medicine" (*Pereira*, 'Th. & M. M.,' 4th ed., i, 752). In doses of $\frac{1}{2}$ gr. to $\frac{3}{4}$ gr. each, combined with calomel, it is a powerful and excellent alterative in acute rheumatism and many skin diseases. Of all our sudorifics it is perhaps the most valuable, and the one most generally available. Triturated with 16 to 20 times its weight of sulphate of potassium, it forms an excellent substitute for antimonial powder and James's powder, as a diaphoretic, in doses of 2 to 4 gr.

Whenever much gastric or intestinal irritation is present, tartar emetic should be avoided if possible or very cautiously administered, and then combined with an opiate or some other sedative. It should also be given with caution to children; as, according to Messrs Goodlad and Noble, even in small doses it sometimes acts as a poison on them.

In *veterinary medicine* it is employed to promote diaphoresis and expectoration, and to reduce arterial action, particularly in fevers, and catarrhal affections, the dose for HORSES being 20 gr. to 1 dr., or even occasionally $1\frac{1}{2}$ dr., in gruel, thrice daily; also sometimes as a diuretic and vermifuge, in doses of 1 to 2 dr., combined with tin-filings, for two or three successive days, followed by a purge of aloes. The usual dose for CATTLE is 20 gr. to 1 dr.; SHEEP, 5 or 6 to 20 gr.; SWINE (chiefly as an emetic), 2 to 5 or 6 gr.; DOGS (chiefly as an emetic), 1 to 3 gr. It is sometimes, though seldom, used externally, as a counter-irritant in chest affections, &c.; but its employment thus requires caution.

Pois., &c. That from large doses has been already noticed under ANTIMONY (which *see*). In poisoning the treatment is the entire disuse of all antimonials, followed by tonics, a light nutritious diet, the use of lemon-juice or ripe fruit, a little wine, warm baths, and mild restoratives generally.

Antimony, Tar'tarised. See ANTIMONY, TARTARATED.

Antimony, Vit'rified. See ANTIMONY, GLASS OF.

Antimony. Origin of the Name. "The origin of antimony is a remarkable circumstance. Basil Valentin, Superior of a College of Religionists, having observed that this mineral fattened the pigs, imagined that it could produce the same effect on the holy brotherhood. But the case was seriously different; the unfortunate fathers, who greedily made use of it, died in a very short time. That is the origin of its name, which I have written according to the pure French word" (Anti-moine = against monks) (*D'Israeli*, 'Curiosities of Literature,' 2nd edition, vol. ii).

ANTIPERIODICS. Medicines which prevent or relieve the paroxysms of certain diseases which exhibit a periodic character. The most important are: Cinchona bark and its alklaoids, quinine cinchonine, quinidine and cinchonidine beberu bark and its active principle, beberine; salicin, salicylic acid and its salts; *Eucalyptus globulus*; and arsenic. Their mode of action is at present unknown.

ANTIPHLOGIS'TIC (-flo-jĭs'-). *Syn.* ANTIPHLOGIS'TICUS, L.; ANTIPHLOGISTIQUE, Fr.; ANTIPHLOGISTISCH, Ger. In *medicine*, the common epithet of remedies, agents, and treatment (ANTIPHLOGIS'TICS; ANTIPHLOGISTICA, L.), which lessen inflammatory action, or allay the excited state of the system which accompanies it. Of these the principal are bleeding, purging, a low diet, cooling beverages (as water and acidulous drinks), and sedatives generally.

ANTIPYRETICS. Medicines which reduce the temperature in fever. The principal agents used for this purpose are: Cold baths, cold applications, ice, diaphoretics, alcohol, chloral, quinine, salicylic acid and its salts, eucalyptol, essential oils, aconite, digitalis, veratria, purgatives and venesection. See FEVER, and under the agents named.

ANTIPYRIN. *Syn.* ANALGESINE. Dimethyloxychinizin ($C_{11}H_{12}N_2O$). This synthetically prepared substance is, according to Dr Knorr, one of a series of derivatives from a hypothetical base to which he has given the name 'Chinizin.' It forms colourless prismatic crystals, freely soluble in water and alcohol. With ferric chloride a solution gives a deep red colour. It melts at 110° to 113° C.

Uses. Given internally as an antipyretic, reducing temperature by increasing heat radiation. Useful in chronic rheumatism, and rheumatic neuralgia, also in headache and typhoid fever; largely used as a remedy for Russian influenza during the epidemic of 1889-90.—*Dose*, 5 to 30 gr. every 3—4 hours.

ANTI-RHEUMATIC DROPS (*Roll*, Amsterdam). A turbid, dark-brown liquid, which consists of a solution of spirituous extract of aconite in a decoction of couch-grass root, and to which some tincture of opium with saffron and oil of valerian have been added.

ANTI-RHEUMATIC SALVE, Mrs HUNGERFORD'S (*Wedecke*, Berlin). Recommended for acute and chronic rheumatism, gout, and nervous pains. Camphor, 1 grm.; carbolic acid, 1 grm.; simple cerate, 12 grms. (*Schädler*).

ANTISCORBU'TIC (-skor-bū'-). *Syn.* ANTISCORBU'TICUS, L.; ANTISCORBUTIQUE, Fr.; ANTISCORBUTISCH, WIRKSAM GEGEN DEN SCHARBOCK, Ger. Good against scurvy. In *medicine*, an epithet of remedies, agents, &c. (ANTISCORBU'TICS; ANTISCORBU'TICA, L.), used in scurvy. Lemon-juice, ripe fruit, milk, the salts of potassa, green vegetables, potatoes, meal-bread, fresh meat, and raw or lightly boiled eggs, belong to this class.

ANTISEP'TIC. *Syn.* ANTISEP'TICUS, L.; ANTISEPTIQUE, Fr.; ANTISEPTISCH, FÄULNISSWIDRIG, Ger. An epithet of substances, agents, &c. (ANTISEP'TICS; ANTISEP'TICA, L.), that impede, arrest, or prevent putrefaction. The principal

antiseptics in common use are culinary salt, saltpetre, spices, sugar, vinegar, carbolic acid, creasote, iodoform, salicylic acid, boric acid, perchloride of mercury, iodine, and alcohol; to which may be added intense cold, desiccation, and the exclusion of air. Among ANTISEPTIC MEDICINES, bark, dilute acids, quinine, wine, spirits, camphor, charcoal, and yeast, take the first rank. See PUTREFACTION, SOLUTIONS (Antiseptic), &c.

Antiseptic Dressings. These are made by charging various substances, such as gauze, lint, wool, or peat, by immersing them in solutions of the various antiseptic agents. Those in common use are, carbolic gauze, boric acid lint, salicylic acid wool, iodoform wool, sal alembroth wool, and tarred tow.

ANTISPASMOD′IC (-spăz-). *Syn.* ANTISPAS′TIC; ANTISPASMOD′ICUS, L.; ANTISPASMODIQUE, Fr.; KRAMPFSTILLEND, Ger. In *medicine*, an epithet of substances and agents (ANTISPASMOD′ICS; ANTISPASMOD′ICA, L.) which allay spasms and convulsions. It is frequently incorrectly applied to anodynes and narcotics, which soothe pain, but do not repress muscular spasm. They may be arranged in groups as follows: Valerian, valerianic acid and its salts; musk, castor, assafœtida, sumbul, and galbanum, camphor, brominated camphor, oil of amber; ammonia and its carbonate; alcohol, ether, acetic ether, chloroform, amyl nitrite; bromide of potassium, bromide of ammonium, conium, lobelia, opium, gelseminum, Indian hemp, belladonna, stramonium, and the essential oils. As adjuvants may be mentioned: Cold baths, moderate exercise, friction, heat, and moisture; also quinine, arsenic, zinc, and silver.

ANTISUDIN, a remedy for sweaty feet (*Mandowski*, Annaberg). Powdered alum (*Hager*).

AORT′A. [L., Ger.] *Syn.* AORTE, Fr. In *anatomy*, the main trunk of the arterial system, arising immediately from the left ventricle of the heart, and giving origin to all the other arteries of the body, except the pulmonary artery and its ramifications, which permeate the air-vessels of the lungs.

AP′ATITE (-tīte). In *mineralogy*, native tricalcium phosphate (phosphate of lime). It is found in Devonshire and Cornwall, and abundantly in Spain, whence it is imported for use as manure, and recently particularly for the manufacture of ARTIFICIAL GUANO. Its powder phosphoresces on burning coals. It differs from phosphorite in not containing fluorine.

Apatite (phosphate of lime of similar constitution to bone-earth, $Ca_3(PO_4)_2$) is found in every fertile soil, of which it is an essential ingredient.

APE″RIENT (ă-pēre′-ĕ-ĕnt; -pĕr′-, as marked by Mayne and Smart, though etym. correct, is less usual). *Syn.* APER′ITIVE (-tĭv); APER′IENS, L.; APÉRITIF, Fr.; ABFÜHREND, ÖFFNEND, Ger. In *medicine*, opening, laxative, gently purgative; usually applied as an epithet to substances and agents (APE′RIENTS; APERIEN′TIA, APERITI′VA, L.) which, in moderate doses, and under ordinary circumstances, gently, but completely, open the bowels; and in this respect rank between the simple laxatives on the one hand and the stronger purgatives and cathartics on the other. Among these may be named as examples—Aloes (when combined with soap or aromatics), Castile soap, castor oil, compound extract of colocynth (in small doses), compound rhubarb pill, confection of senna, cream of tartar, Epsom salts, Glauber's salt, phosphate of sodium (tasteless purging salt), Pil. Rufi, seidlitz powders, cold-water compress over the abdomen, &c. Several of these, in larger doses, become active purgatives or cathartics. See PURGATIVES, also DRAUGHTS, MIXTURES, PILLS, &c.

APERTURE. Captain Abney gives the following directions for finding the available aperture of a doublet lens:—Focus a distant object on the ground glass of the camera; now replace the glass accurately by a screen of opaque paper, in the centre of which a small hole has been punctured. The front combination of the lens is illuminated by the rays of light coming through the orifice, and the diameter of the disc of light seen on the front of the lens gives the available aperture of the lens when used with that diaphragm. It is necessary to apply some such method, inasmuch as the apertures in the diaphragms do not show accurately the available apertures of the lens. See PHOTOGRAPHY.

APHASIA (ἀ priv., and φημί or φάω [Gr.], I speak). *Syn.* APHEMIA, ALALIA; APHASIE, Fr. The name given to a defect of speech arising from cerebral disease. A person suffering from *Aphasia* is unable to utter any proposition, but may nevertheless be capable of pronouncing one or more words more or less distinctly, which shows that the disease is not due to a defect of the vocal organs. Moreover, by his expression, signs, and gestures it is obvious that he can understand what is said to him and is capable of formulating a reply, but not of uttering it. This condition must be clearly distinguished from *Amnesia*, a disorder of the brain, in which the patient uses *wrong* words which may vary greatly in degree from mere failure to utter *certain* words to complete inability to utter an intelligible sentence. *Aphasia* is most common in cases of *right hemiplegia. Amnesia* occurs in cases of hemiplegia on either side of the body.

APHELION. In *astronomy*, that point in the orbit of a planet or comet which is furthest from the sun, and at which the angular motion is slowest.

APHIS. It will be useful to give here the four divisions of this important family, of whose tribes and species almost all the members are destructive to agricultural crops, fruit crops, vegetables, trees, shrubs, and vegetation generally.

The Family *Aphididæ*.—Division 1. *Aphidinæ*. —Embracing among many other species the hop, plum, bean, pea, and apple Aphides.

Division 2. *Schizoneurinæ*.—Embracing among many other species the Woolly Aphis, the *Schizoneura fodiens*, and the Elm Aphis.

Division 3. *Pemphiginæ*.—Embracing among many other species the Poplar Gall insect.

Division 4. *Chermesinæ*.—Embracing among many other species the *Phylloxera vastatrix* and the Larch Aphis.

Aphis Brassicæ, Linn. THE CABBAGE APHIS. Like all the aphides, or plant lice, the *Aphis*

brassicæ in some seasons is very troublesome, while in others it is scarcely noticed. This is no doubt due to the conditions or influences of the preceding season, as to whether they have been favourable for the increase of the insects in respect of food supply, and weather; also to the receptivity of their various food plants at the time of the attack. It is held by some who have observed the habits of aphides that plants in a perfectly healthy state, which have not been affected by white frosts and sharp variations of temperature, offer no encouragement to them to remain and multiply. On the other hand, it is averred that plants in an abnormal condition caused by soil, weather, absence of essential elements, or other unfavourable circumstances, are especially liable to aphis blight. No plants under the sun are more delicate and subject to injuries from climatic vagaries than hop-plants, and these are more frequently injured by aphides than any others. And with regard to the *Aphis brassicæ* it has been noticed that it generally appears first upon swede and turnip plants in parts of fields where the soil is shallow, and where the plants have been subjected to checks and drawbacks during their growth.

These aphides do not arrive so early as others, such as the hop aphis, the rose aphis, and the lime aphis; or, at least, they have not been noticed in any numbers until after the roots have attained a fair size. It is believed that the first generations are bred upon weeds, such as charlock, hedge-mustard, and fly from thence or are conveyed by the wind to cultivated plants of the Brassica tribe. But they increase marvellously fast when the surroundings are suitable, covering the under sides of the leaves with green lice with mealy coats, and the filthy *excreta* peculiar to them, while 'honey-dew' falls on the upper surfaces of the lower leaves. The growth of the roots is arrested; instead of swelling out, their shanks, or stalks are unnaturally elongated, while the leaves curl and turn brown after a time. Loss of weight of roots is often very great, and the leafage is in many cases practically spoiled for sheep or cattle food if the aphides remain unto their last generations.

Market gardeners in Essex, Bedford, Kent, Lancashire, and other counties suffer considerably in some seasons. These aphides attack all kinds of vegetable of the Brassica tribe, even getting in the hearts of cabbages and of cauliflowers, and spoiling them for sale.

Mr Buckton says, "This insect feeds on a variety of plants, such as *Raphanus sativus, Sinapis arvensis, Capsella bursa-pastoris,* and the garden cabbage, *Brassica oleracea,* both the upper and under sides of the foliage of which last plant it often crowds in such numbers that the leaves become hidden by the living mass. Indeed, sometimes, weight for weight, there is more animal than vegetable substance present" ('A Monograph of British Aphides,' by G. B. Buckton, F.R.S., vol. ii, p. 34).

In 1885 it was seen that the charlock plant (*Sinapis arvensis*), as well as those of the penny-cress (*Thlaspi arvense*), were much infested with the larvæ of this insect about the middle of June. Also the shepherd's-purse (*Capsella bursa-pastoris*) was much affected. Later on, and when the wild plants had got old and sticky, the turnip and swede plants were found to be covered with aphides. No actual migration was noticed, but the practical disappearance of them from one set of plants, and their appearance upon another set, led to the inference that such had taken place.

The *Aphis brassicæ* is known in France and Germany, and in other countries of the Continent. Harris and Fitch both speak of it as injurious to cruciferous plants in the United States.

Life History. This is a species of the genus *Aphis,* of the family *Aphididæ,* and the tribe *Aphidinæ,* having the same extraordinary powers of reproduction as all the other species of this most destructive race of insects. Taking first the winged female, which brings forth living young, and is the medium of infestation of crops, it is provided with ample fore, or superior wings, with an expanse of five lines, or very close upon half an inch, while its body is only about two lines or the sixth of an inch long. In colour this winged viviparous female is black as to the head and thorax, with a green or yellowish-green abdomen, and very dark yellow legs. When the food supply falls short, or is not suited to the aphides, the larvæ assume the pupal form, and the females are generated and are carried floating in the air by their long wings to seek plants upon which to found new colonies. Upon settling down in suitable quarters these females produce living larvæ, or lice, which in their turn, after the manner of aphides, bring forth many generations of wingless larvæ like unto themselves. These wingless viviparous larvæ have oval bodies of a green colour, getting much darker as the autumn approaches, with six legs and a short black cornicle on either side of the tail. They are covered with downy or mealy coats, and with their rostra, or beaks, extract the juices from the leaves. Failure or the unsuitableness of food supply, or, it may be, the due lapse of time, causes the evolution of oviparous females, which, being duly fertilised by males, lay eggs upon the plants upon which they are present. It is not known whether the males are winged or wingless.

Now it is almost certain in the case of cultivated crops of turnips, swedes, and rape infested with aphides, that in the common course of husbandry the eggs and any larvæ that might remain would be destroyed. It may be inferred, then, that the continuity of existence is carried on upon wild cruciferous plants by means of eggs laid by the few females that may have remained in the original home, or by wingless viviparous females that have hibernated close to the roots of these plants. No amount of cold affects the eggs, and the wingless viviparous females have been seen upon plants, and producing young in cold weather in February and March; and there is no doubt that these females in winter, when there is not an extraordinary amount of cold, bring forth young as soon as there is any vegetation available for their support.

Prevention. In the circumstances of ordinary farm practice it is almost impossible for these aphides to be harboured during the winter upon the crops they have injured during the summer, as these are either fed off by sheep, or are topped

and tailed and carried into clamps or lodges to be consumed by cattle or sheep. The tops are spread and the land is ploughed at once. Cabbage plants put in during the autumn are of course excepted. It is quite possible that the aphides may be carried over on or near these, as well as in the case of other plants of the *Brassicæ* intended for seed, and put in during the autumn. But without doubt the main attack of these aphides has come from weeds which have retained the eggs during the winter, have harboured the wingless females near their stems and roots, and have furnished them with food in the earliest spring, and nourished them until the cultivated plants were ready for them.

Charlock and all other cruciferous weeds must be proscribed from fields and their outsides, which should be closely brushed in early spring. Plants of charlock are very frequently found in clover leys. These are dangerous sources of mischief, for it must be remembered that a few viviparous females can, in favourable conditions, soon produce enough offspring to blight square miles of crops. Indeed, Réaumur states that one aphis may be the progenitrix of 5,904,900,000 aphides during her brief life ('Memoires pour servir à l'histoire des Insectes,' par Réaumur).

Remedies. Washing the plants with a decoction of soft soap and quassia, in the proportions of 7 or 8 lbs. of soft soap, 7 or 8 lbs. of quassia, and 100 gallons of water, is almost a certain cure if carried out properly. This may be applied with the washing engine with pumps and long hose, like that used for washing hop plants, only set upon higher wheels. It should be stated here that it is necessary to use soft soap, or some composition of this nature, in all washes adopted as remedies for aphides, in order to fix the wash upon their bodies. This is especially necessary in the case of the *Aphides brassicæ*, the bodies of whose larvæ are thickly covered with a downy or mealy substance. This washing is an expensive process, and would cost from £2 to £3 per acre. It requires also great care and constant supervision to ensure a regular and general distribution of this wash. The hose should be furnished with jets or sprays, somewhat curved at their extremities, that they may be held under the leaves.

There are several insects which destroy this aphis in its various stages.

First of all are the several species of *Coccinellidæ*, lady-birds, which are of incalculable benefit in clearing off this and other kinds of aphides, in the most rapid and wholesale manner.

Then there are three or four different species of Ichneumon flies, described by Curtis as most destructive to the *Aphis brassicæ*.

One of these especially harasses them. It is named *Trionyx rapæ*, belonging to the family *Ichneumonidæ* of the HYMENOPTERA. It is a pretty insect of a dark brown colour, with several yellow rings round the lower part of its body. In length it is not quite the sixth of an inch, with a wing expanse of nearly the fourth of an inch. The female puts an egg into the body of the larva of the aphis, and its product, a tiny maggot, as Mr Buckton says, 'solitarily inhabits each individual' feeding upon its vitals.

Aphis Fabæ, Kirby and Spence. THE BEAN APHIS, or BLACK DOLPHIN. *A. rumicis*, Linn. Bean plants are often noticed to be swarming at their tops with black insects some time before they come into flower. Frequently these are so numerous as to prevent the plants from developing flowers, and if the flowers do struggle forth they produce but few beans, and these of a small, stunted description. If the heads of the bean plants in fields badly attacked be examined they will be found covered with black aphides, whose beaks are thrust into the tissues of the stalks and leaves, from which they are sucking out the juice. The leaves and stems below them are covered with a viscous fluid. After a time this becomes black from the admixture of the excretions of the numerous insects. This filthy composition hinders, or absolutely checks, the respiration of the plants. With their sap exhausted by the myriad suckers, and their leaf and stem tissues choked up, the plants soon languish and die.

In 1885 the crop in many bean-fields was almost ruined by these aphides. The beans were few and small, and the haulm short and almost useless. A sickly odour went up from the infested plants, such as is smelt oftentimes in badly blighted hop-gardens. It may be remarked here that almost every species of aphis was plentiful and unusually destructive in 1885. Plants of corn, fruit, hops and vegetables, flowers and shrubs, trees and weeds, were all more or less attacked and injured by their peculiar aphis pests. The circumstances of the winter and spring seasons appeared to suit their hibernation and propagation; while the weather of the spring, with its more than usual variation of temperature, rendered their plant-food particularly pleasant to their tastes.

From the quantity of saccharine matter in the honey-dew, or secretions of the aphides, it seems that a large or abnormal quantity of sugar in the composition of the sap of plants is necessary to encourage and sustain their attack. Alternations of temperature tend to increase the amount of sugar in the juices of plants. The more delicate and susceptible plants are more quickly and in a greater degree affected in this respect, and become infested with aphides whose progenitors have migrated from less attractive quarters. Thus the bean aphis, which is common to the dock (from whose Latin term *Rumex* it takes its name) as well as to the broom and furze, forsakes these plants and flies to the bean plant, and if the bean plant is in a suitable condition it remains and multiplies upon it.

Life History. The perfect insect, the winged viviparous female, is quite black, of a somewhat shiny appearance. The male, which has wings, is also black.

Both larvæ—wingless viviparous females—and pupæ are at first of a lighter colour, but they soon become black.

At the end of the summer, or when the food supply has ceased, the generations of aphides are produced with wings and fly away to their winter retreats. Here they deposit wingless females, which lay eggs upon the leaves and in the axils of the leaves of the dock, broom, furze, thistle,

borage, and other common plants, to be hatched out in the spring. From these eggs larvæ are hatched. These produce living larvæ endued with the power of reproducing living scions for several generations without coition. This parthenogenetic reproduction is continued for several generations. But when food fails, or is not appreciated, generations intervene having wings to carry them to fresh and more congenial plants. It appears that bean plants afford especially grateful food for these aphides, because in favourable circumstances they increase upon them with marvellous rapidity and soon ruin the crop; whereas upon their normal hosts—docks, thistles, broom, furze, and others—their ravages are seldom appreciable.

Prevention. Docks and thistles must be religiously excluded from fields and hedgerows bounding fields.

Remedies. It is a frequent practice to top bean plants before they come into flower in order to make them throw out flowers low down the stems and increase their fruitfulness. This should be done when aphides appear, but the leaves and tops thus cut off *should be taken away.* If they are left on the ground the larvæ will crawl up the stems. Horse-hoeing would bury and destroy the greater part of them if the plants are set wide enough apart to permit this operation at so late a stage. Or the leaves and tops might be raked together with garden rakes, or picked up in baskets and carried away.

In market gardens bean plants attacked by aphides may be washed with quassia, soft soap, and water, in the proportion of 4 lbs. of soap and 4 lbs. of quassia to 100 galls. of water, put on by means of hand syringes fitted in pails. This operation would be efficacious equally in large bean-fields, but the difficulties and expense of application would be great.

Aphis Humuli. THE HOP FLY. This is a species of the large tribe *Aphidinæ*, of the genus *Phorodon*, thus distinguished because its species have toothed frontal tubercles, most developed, according to Mr Buckton, in the wingless viviparous females. Very many of the cultivated and wild plants of this country are infested with peculiar species of aphides, which in some seasons favourable for their development and increase are infinitely destructive. Rose growers know how often these flowers are spoiled by the rose aphis. Fruit producers often suffer much from the species which attack currant bushes, plum, damson, and peach trees. The lime tree, whose blossoms are delightfully fragrant, is constantly so beset by the *Pterocallis tiliæ* that it is unpleasant to sit under its shade on account of the showers of honey-dew that fall from the legions of insects on its leaves.

The losses to hop planters occasioned by the hop aphis have been almost incalculable. Hop plants have been liable to its attacks for at least 200 years. It appears from records of these attacks, 'black blight,' that they have been of more frequent occurrence during the last 50 years. It would be difficult to give accurate estimates of the losses to hop planters and to the whole community caused by the ravages of aphides. In the last serious blight, in 1882, not a hop was picked in many important hop-growing parishes, and it was estimated that the whole produce of the hop land in England, 65,619 acres in 1882, did not exceed 114,832 cwt., or an average yield of 1¾ cwt. per acre. The annual average yield of the English plantations is about 7 cwt. per acre, or a total yield of 459,333 cwt. upon the acreage of 1882, which at £7 7*s.* per cwt., the average price of English hops, taking the 20 years previous to 1882, would represent a total value of £3,376,177. The picking of an average crop of hops upon the acreage of 1882 (the hop acreage in 1884 had increased to 69,258 acres) would cost from £350,000 to £380,000, whereas the cost of picking the crop of 1882 did not amount to more than £155,000; so that the labourers who depend upon the hop-picking suffered considerably.

Mode of Attack and Results. The hop aphis appears upon the hop plants generally about the beginning of May, and, if the conditions of temperature and of the plants are favourable, it propagates with astonishing rapidity. The never-ending, still-beginning swarms live entirely upon the sap of the plants, and suck it up by a kind of pumping process with their monstrously long beaks, attacking first the youngest and smallest leaves of the leading shoots, which are more succulent than the older leaves. After a week or two the growth of the plants is checked and they struggle in vain to reach the tops of the poles. Their juices are exhausted by the continuous suckings of these insects, and the respiratory action of the leaves is stopped as to their under surfaces, upon which the aphides always congregate and feed, by their filth and exuviæ, and upon their upper surfaces by the 'honey-dew,' a peculiar glutinous sweet secretion ejected from the bodies of the aphides; this falling upon the leaves effectually prevents them from absorbing oxygen into their tissues. After this, which, as a rule, happens from three weeks to a month after the appearance of the insects, the plants give up, the leaves turn black and fall off, and all chances of a crop are lost. Heavy thunder showers often give renewed vigour to the plants at this stage by cleansing the leaves and partially restoring respiration, and this makes country folks say that lightning kills the aphides.

Sometimes it happens that aphides do not appear upon hop plants, or at least not in dangerous numbers, until the cones are formed; in this event they get inside the cones and increase with greater rapidity than ever, blackening and disintegrating these so that they cannot be picked. This is the most feared kind of attack, as no remedies can be applied when the cones are formed, nor can the insect enemies of the aphides get at them easily.

With regard to the liability of hop plants to be blighted by aphides, there is no doubt that arrested growth and sudden checks from change of temperature predispose them, as vines and other plants are predisposed, to receive insect attacks, as well as various disorders. It is deemed expedient, therefore, by practical planters, as by practical vine cultivators, not to dress or cut the plants too early in the spring, because young shoots, especially, as Dr Sachs says, when the parts of the plant are of small size and have a large hairy surface, as is the case with the leaves

and internodes of the hop plants, are particularly liable to be injured by radiation in the clear cold mornings of the spring season.

In 1882 the advantages of late dressing were apparent. Severe white frosts in the beginning of April much injured the forward bines and made them stunted and brittle, while those dressed late, and therefore untouched by the frosts, escaped injury to some extent, and in several remarkable instances were comparatively unharmed by the blight.

Life History. Entomologists have not absolutely decided as to the manner in which the life of this aphis is carried on through the winter; but there is every reason to believe that it is continued by eggs deposited in the autumn by wingless females, as well as by hibernating aphides, at least in suitable winters. Wingless (apterous) females invariably produce the eggs, and wingless females are, it is believed, also the direct products of the eggs. These are important facts leading to valuable suggestions of means of prevention, for they prove almost conclusively that the egg is placed upon or near the plant upon which its depositor has been nourished. In the case of the hop plant which is cut down nearly close to the ground in September, the aphis deposits its eggs in the ground hard by, or upon the short pieces of bine that are left upon the hop stocks, and upon the bines that are subsequently carried away for litter.

The larva extruded from the egg is nearly as large as the full-grown larva, or louse, as it is commonly called in the hop districts, but it presents certain differences of form, and particularly in respect of its cornicles. It is very active, having an enormous beak or rostrum, which it uses at once, and if conditions of food and temperature suit it begins to propagate its species after the extraordinary manner of reproduction of successive broods of larvæ or lice, like itself, without sexual coition and influence of the male. Professor Owen writes of this as follows:—"This larva, if circumstances of food and warmth be favourable, will produce a brood, and, indeed, a succession of broods, of larvæ like itself, without any connection with the male. In fact, no winged males have appeared at this season. If the virgin progeny be also kept from any access to the male each will again produce a brood of the same number of aphides; and carefully prosecuted experiments have shown that this procreation from a virgin mother will continue to the seventh, ninth, or eleventh generation, before the spermatic virtue of the ancestral coitus has been exhausted." Réaumur has stated that one aphis may be the mother of 5,904,700,000 individuals during the month or six weeks of its existence. With this amazing power of increase it is not wonderful that the hop plantations are devastated, nor that the hop planters anxiously seek information and methods of prevention and remedies against these attacks.

A general distribution of aphides is made throughout the hop plantations by means of winged females carried by the wind. These are perfect insects which are viviparous, and they appear from time to time, in circumstances and from some causes not clearly ascertained, among the broods of wingless larvæ upon the leaves. Buckton remarks that a change takes place in the larva of the aphides. Swellings occur on the sides of the meso- and meta-thorax with which the wings of this future imago, or perfect insect, are developed. These altered forms constitute the pupa, which often shows considerable difference both in markings and colour.

It is certain that when food begins to fail upon aphis-infested plants, batches of winged aphides appear and fly away to fresh fields and pastures new.

There is a regular general migration, or movement of winged females, early in the season, between the 20th and 31st of May generally, which can hardly be caused by a failure of food, and a large migration in the autumn when all the generations of viviparous larvæ are exhausted. The male comes on the scene, always in winged form, towards the autumn, and pairs with the wingless oviparous female, from which coition the innumerable swarms are generated, to blight and ruin the crop of the next season.

Miss Ormerod is of opinion that a variety of hop aphis, *Aphis mahaleb*, also infests the hop plants equally with the sloe and damson trees, and that in blighting seasons winged females of this variety migrate from these to the hop plants. Miss Ormerod points out that these are very slight varieties of the common species, and are so similar in habit as regards injury to hop plants that for all practical purposes they may be considered one. This adds very much to the chances of blight, as damsom trees are very largely cultivated in all parts of Kent, and in Herefordshire and Worcestershire, on all sides of the hop plantations.

Prevention. One of the best modes of prevention in the case of aphides is undoubtedly to put caustic substances, as lime, soot, lime ashes, and others, round the stocks, or plant-centres, during the winter. Bines should be carefully collected and removed from the hop-gardens before February. All dead pieces of bine should be cut away from the stocks and burnt or taken away. The outsides of the hop-gardens should be kept brushed, and weed-growth prevented. If damson trees near are infested with aphides—not the ordinary plum aphis (*Aphis pruni*), which is distinct from the hop aphis, but the Mahaleb variety, which so closely resembles it—they should be washed with soft soap and water to prevent the migration of flies to the hop plants.

Remedies. No remedy for aphis blight in any way effective was discovered until about 35 years ago, when washing the plants was adopted to disturb the insects and to cleanse the leaves. Water alone was used, without much effect. Then soft soap was used with the water, and sometimes a little tobacco juice was added. This mixture is fairly efficacious if applied properly and often enough, but the best mixture is water, soft soap, and quassia. Quassia and water will not answer without soft soap, as the aphides have the power of resisting liquid without soap. It simply runs off and over their bodies, as water runs off and over the backs of water-fowls. When soap is mixed with water and quassia the detergent nature of the soap neutralises their oily secretion

and exposes them to the action of the liquid, and fixes the bitter of the quassia on the leaves, making them unpalatable. The soft soap also acts as a lubricator of the pumps of the machines employed for washing the plants.

The best composition is—

100 gallons of water .	Soft water if possible; or if hard, with soda added.
4 to 5 lbs. of soft soap	Pure.
6 to 8 lbs. of quassia .	Boiled well to get full extract.

This wash is sent up, squirted up and over the hop plants—the play of the jet being directed to the under surfaces of the leaves—by means of large garden engines with strong pumps and long flexible hose, and jets held under the leaves by men. Large planters employ washing machines drawn by horses between the rows, whose pumps are worked by the wheels and force the wash up and over the plants through a series of tubes perforated at intervals.

This washing process in order to be perfectly successful must be commenced directly there is any deposit of lice upon the leaves, and continued systematically until all of these have been cleared off. In some seasons fresh flies are continually wafted to the plants, and in this case it will be necessary to wash frequently and watch the plants with great care.

The advantages of washing hop plants for aphis blight were clearly shown in 1882. Planters who washed grew crops of from 7 to 9 cwt. per acre, while those who did not wash their plants grew nothing or next to nothing.

In connection with remedies against aphides it should be pointed out that the chief natural enemies of the hop aphides are the little spotted beetles commonly called lady-birds, *Coccinellæ*, and that these should be religiously preserved in all hop districts. They have been known to avert an impending blight, coming in countless quantities and devouring the aphides as fast as they were generated. In America insects and animals that destroy insects injurious to crops are encouraged and protected. Among one of the remedies for the attacks of insects given by the entomologist of the State of New York is "colonising lady-bugs, the *Coccinellidæ*, upon house plants and other vegetation infested with plant lice."

Aphis Mali, Fabricius. The Apple Aphis. In the apple-producing districts this is known as the green fly. It is very frequently confounded with the woolly aphis, *Schizoneura lanigera*, though, as shown in the account of this insect, it is quite distinct. An examination of these two insects will show that the shape both of the perfect insects and of the larvæ is different, and that the neuration of their wings also widely differs. The apple aphis belongs, in common with the woolly aphis and many other species, to the family of *Aphididæ*, but it is a member of the division *Aphidinæ*, while the woolly aphis is placed in the division *Schizoneurinæ*.

The apple aphis does not live upon the sap of the apple trees sucked from the branches and stem, like the woolly aphis, but derives its food solely from the juice of the leaves and blossoms. It makes its appearance as soon as the buds begin to swell and the leaves show signs of coming forth, and it follows up the blossoms from their earliest development. It is very dangerous to the blossoms of certain kinds of apple trees, whose leaves are but slightly advanced when the blossom is formed. And, as a rule, the blossom of apple trees appears before the leaves are perfectly developed. The aphis attacks the blossoms, being especially attracted to them by their saccharine qualities, and either prevents the process of fructification, or, if this is accomplished in spite of it, so besets the tiny fruits that, weakened by the extraction of their juices and begummed with viscous honey-dew, they are unable to 'set' properly. Those that perchance struggle out of these surroundings rarely attain to full size and perfection of shape, qualities, and colour. As the leaves come out their under surfaces are occupied by the larvæ of the aphis, and soon curl up, get black, and after a time fall off, leaving the trees, after a bad and persistent attack, as bare as in winter days, and emitting a sickly smell from all sides.

It has been noticed that apple trees suffer most from this aphis when white frosts have been severe and numerous about the period of the blossoming and the putting forth of leaves. Vigorous growth is checked by the action of white frosts, and, as in the case of hop plants and other plants liable to aphis attack, the sap appears to be rendered grateful to the palates of the parasites by the sharp variations of temperature. In early seasons, when leaves and blossoms have been pushed forward and white frosts have followed, aphides are generally more troublesome than in normal seasons, when the blossoms come out towards the end of April.

There is an old saying as to the blossoming of apple trees which has words of wisdom, though they are not set very rhythmically:

> If apples blow in March,
> For apples you may search.
> If apples blow in April,
> Apples will be plentiful.
> If apples blow in May,
> You'll eat them night and day.

Apple trees planted on low ground are more subject to receive injury from aphides than those higher up, as they blossom earlier and are more affected by white frosts.

Should the blossoms escape so that the apples are formed, it does not by any means follow that they are out of danger from aphides. Not unfrequently these come on so fast that the leaves cannot perform their proper functions, and finally the apples drop off. In some seasons and in some circumstances apple trees are so persistently attacked by the aphides that they do not recover for two or three years. Cider makers in Devonshire and Somersetshire and in the other cider-producing counties dread the appearance of the 'blight,' as it is termed, because it not only diminishes the quantity of the crop, but also affects the quality of the cider. Occasionally it causes much disappointment and loss in the orchards of Herefordshire, Worcestershire, and Gloucestershire, especially in those near rivers and streams, and after variable spring seasons.

This insect is cosmopolitan. The American fruit growers suffer much from its ravages, and declare that it was imported from Europe, in

revenge probably for the imputation of Europeans that the woolly aphis, American blight, was exported from American shores. Professor Asa Fitch is clear that the same insect is common to America and Europe; but he adds, "Upon this side of the Atlantic it has been introduced by trees brought from Europe."

The Canadian orchards are often infested with this pest. Mr Saunders, the President of the Fruit Growers' Association, and of the Entomological Society of Ontario, reports that this species of aphis is very common throughout the Northern United States and Canada, and that during the year 1885 appeared in such numbers in some localities as to excite much alarm among fruit growers ('Popular Papers on Entomology,' by W. Saunders, London, Ontario). Köllar, Kaltenbach, and Taschenberg all speak of its destructive work in Germany. The last shows that it occasioned great losses in that country in 1869 ('Praktische Insekten-Künde,' von Professor E. L. Taschenberg). M. Baltet, the enlightened pomologist of Troyes, writes that the *Aphis mali* has long been known in all parts of France, and is equally troublesome to the cider makers in Normandy and Brittany, and to the cultivators of dessert apples in the central and southern departments.

The increase and injurious effects of the apple aphis are advanced by the neglected and unpruned condition of the trees. Where the bark is thick and full of deep cracks and the branches are thickly twisted together, and where mosses and lichens are permitted to cluster upon the boughs and twigs, the insects are generally far more numerous and prejudicial than on trees that have been well scraped, well pruned, and cleared from vegetable parasitic growths. The sad, almost scandalous state of many orchards in this country serves to intensify and to perpetuate the visitations of this and other insects. A close inspection of typical orchards will reveal a deplorable condition, in which it seems hardly possible that much fruit or good fruit can be yielded. Woolly aphides may be seen rampant everywhere, upon the roots, the trunk, and the branches. Apple aphides will be found producing their last generations, having despoiled the tree of most of its leaves, and blackened those that are left and the few stunted apples with their filth. The caterpillars of the ermine moth are rapidly clearing off the few remnants of leafage left by the aphides, while the codlin moth is causing a continuous dropping of the miserable apples they have spared. Under the bark, or within its deep fissures, swarms of weevils are discovered, reposing after their onslaughts upon the nectareous blossoms; and the bark itself is tunnelled and furrowed by the numerous bark beetles, *Scolyti*, which skurry away when the light discloses their wicked ways. Many other strange creatures are found here, some more or less dependent upon their host for their existence, others making it a refuge from which they will anon escape, to blight, it may be, crops of corn, or fruit, or vegetables.

Life History. Continuity of existence is sustained in the case of the apple aphis by means of eggs, deposited in the autumn in the hollows of the rind close to the leaf-buds, and in the joints of the twigs and smaller branches. These eggs are of a yellowish colour at first, becoming dark brown approaching to black later on. Each female lays from two to four eggs between August and October, according to the character of the season. From these eggs wingless, viviparous, dark green females are hatched, described by labourers as 'great green lice,' by German entomologists as Altmütter and Stammütter, and by Mr Buckton as 'the adult queen aphides' ('A Monograph of British Aphides,' by G. Bowdler Buckton). These produce in about ten days generations of living larvæ smaller than their mothers, of a lighter green shade, which becomes darker in two or three days, with more narrow bodies. Some of them vary in colour from greenish grey to light brown. They also bring forth living larvæ like themselves without any sexual coition, which are also endowed with the same parthenogenetic prolificacy.

As the great green lice, adult queens, have been found upon apple trees at the end of November and towards the end of December, it is thought that the species is perpetuated in certain circumstances by means of hibernating larvæ as well as by eggs. Mr Buckton, a most close observer, who knows more about aphides than any other person living, or who has lived, has not, it seems, found larvæ in the winter. Nor do Miss Ormerod and Taschenberg remark upon this as being within their cognizance. Of course it is possible that the specimens of larvæ found in December were hatched prematurely, though it should be said that the weather had not been abnormally mild. In fact, there had been more than 10° (F.) of frost on two or three mornings.

After a time, during which several generations of larvæ have been produced, a winged viviparous generation of females is evolved, for the obvious purpose of spreading the species from tree to tree and from orchard to orchard. It is a moot point yet as to what determines this evolution, whether it is the quantity or quality of the food, or the action of climate, or—and this is most probable—whether it is predefined by the influence of the ancestral coitus, as Professor Owen terms it ('On Parthenogenesis,' by Professor Owen).

These winged viviparous females are pretty insects, whose lower bodies are of a light green tint with four black dots on each side. Their heads and the upper part of their bodies are black. The wings are long and iridescent, and have peculiar neurations.

The males are small and commonly wingless, and are furnished with beaks, or rostra, so that they can take food. In this respect they differ, as Mr Buckton points out, from the woolly aphides, which have no beaks, and can therefore take no food, and pair immediately after their birth.

Mr Buckton has admirably delineated the egg-laying females, which are without wings and of a roundabout shape, brownish green in colour. These are also evolved in wonderful order from the generations of larvæ, and begin to pair with the wingless males towards the middle of September.

Prevention. It is found that apple trees which have been allowed to grow unchecked, to which

no timely knife has been applied, and upon whose branches and fruit-bearing spurs mosses and lichens rest undisturbed, suffer most from the apple aphis. Apple trees in gardens are not so affected by this scourge as those in orchards, because as a rule they are kept pruned. Air and light permeate their branches. Vegetable parasites are by no means common upon them. There are not many refuges for the aphides. It is obviously difficult, in respect of apple trees in orchards that have been long neglected, to apply means of prevention whose influence would be immediately seen, such as pruning, bark-scraping, and the removal of superfluous and noxious growths. Still, apple producers must not be frightened at the amount of labour involved in such a work, but must carry it out gradually and thoroughly. After an attack of aphides upon apple trees where mosses and lichens abound, hot lime should be thrown over the trees on a foggy day in winter, to remove these lurking-places, and at the same time to kill any hibernating larvæ that might be there, as well as possibly to affect the vitality of the eggs. Superfluous and crossing branches should be cut away; by this means many eggs would be removed.

Remedies. Washings with a mixture of soft soap and quassia are strongly recommended. No wash is more effectual than this. As apple trees that are attacked by aphides are in many instances high and wide-spreading and have innumerable branches, the application of washes is a particularly difficult and tedious process. The manual engines used for washing hop plants when smitten with aphides are the best to employ for this purpose, as they have powerful pumps (these engines can be obtained at the principal ironmongers in the largest towns in the hop districts, as at Maidstone, Canterbury, Worcester, Hereford, Farnham, Robertsbridge—*C. W.*); but even with these it would be impossible to send the liquid up hard enough to dislodge the insects upon the leaves on the uppermost branches. And these engines would scarcely have sufficient power to force the wash up to the tops of the trees. For trees of ordinary height, however, they would be available, as if the wash contained a good proportion of soft soap and a strong solution of quassia, it would rout the aphides by being merely sprinkled upon their bodies, and render their food unpleasant by being simply put upon the leaves and blossoms.

Paraffin oil wash has been thrown up over aphis-infested trees with considerable advantage, though not with such good effect as that of soft soap and quassia, since it does not adhere to the aphides, whose bodies are furnished with some means of resisting ordinary liquids, like water containing soft soap; neither does it remain on the leaves. The wash of soft soap and petroleum combined, in the proportion of from half to three quarters of a gallon of the composition to 100 gallons of water, would be found valuable.

Washing will probably require to be repeated, it may be twice, before the insects are dispersed. This may be considered to be too troublesome and costly. It must be remembered that if it is done early it may not only save the present crop, but also that of the next year and of even subsequent years. As has been shown, a bad attack of aphides materially damages the trees and prevents them from bearing for some time.

There are natural enemies of this insect which do good service in reducing their numbers. *Coccinellæ*, lady-birds, of several species clear them off rapidly in some seasons; and there are two or three kinds of ichneumon flies which cause great havoc in their ranks by depositing eggs within their bodies, whose offspring prey upon their vitals.

Aphis Pisi (*Siphonophora pisi*, Buckton). THE PEA APHIS. This is commonly called the 'green dolphin,' and frequently sadly injures pea plants. Like the black dolphin, it is fostered upon common plants and weeds, as the shepherd's-purse (*Capsella bursa-pastoris*), the common nettle, and others. Its life history is the same as that of the bean aphis, and the sole means of prevention is the eradication of weeds from cultivated land and its neighbourhood as much as possible. Unfortunately there appear to be no remedies against this insect, or, at least, where peas are produced upon a large scale. In market gardens and ordinary gardens washing the affected plants with decoctions of quassia and soft soap, as recommended in the case of the bean aphis, might advantageously be adopted.

Aphis Pruni, Réaumur. THE PLUM APHIS. By no means must this aphis be confounded with the insect which is styled by Miss Ormerod the Hop-Damson Aphis, and which in certain circumstances, and in some stages, appears to be common to the hop plant and to damson and sloe trees. Nor must it be supposed that the Plum Aphis, *Aphis pruni*, confines its attention solely to plum and damson trees. Mr Buckton says it may often be found upon apple trees and upon peach trees ('Monograph of British Aphides,' by G. B. Buckton), and De Geer saw it upon apricot trees. Still, it is the plum aphis primarily, and in some years it is most injurious to the plum and damson crops by exhausting the juices of the leaves with the suckers of the myriads of its progeny, and by causing the young fruits to shrivel up and fall off.

Occasionally it makes its appearance upon the plum and damson trees even before the blossoms have fallen off, and prevents the proper development and formation of the fruit. Usually it arrives just after the blossoming period, and then it checks the growth of the fruit by its continuous drain upon the leaves, and by choking up their stomata with excreta and exuviæ and a peculiar mealy powder that emanates from its body. After a time the leaves roll up and become rusty-coloured and drop off, while the fruits become small by degrees and beautifully less. Those that remain upon the trees are stunted productions without quality and flavour.

In the extensive and most important damson plantations in Kent this aphis is often most destructive, and it should be stated, especially within the last ten years, before which date its attack was comparatively rare, to a famous sort of damson largely cultivated in Kent, known as the 'Crittenden' damson, which is most prolific, of fine flavour, size, and colour, and makes high prices as a rule. An attack of aphides upon these trees is a most serious infliction, as it means if it is persistent, and unless it can be stayed or

modified by remedial measures, a great reduction in the crop and much damage to its quality.

Mr Whitehead says, "I have seen in some seasons, notably in 1882, the damson trees upon many acres of land in Kent which in May were literally masses of lovely white blossoms, looking a month later, in 'leafy June,' as if a hot wind, a very sirocco, had passed over them, with leaves brown or copper-coloured besmeared with honey-dew and filth, and the little damsons rapidly drying up and disappearing."

Greengage trees are also frequently affected, and the trees producing the fine sorts of plums, as the Orleans, Early Rivers, Washington, Prince of Wales, which are cultivated upon a large scale in Kent, Gloucestershire, and Worcestershire, are often rendered unproductive by reason of the visitation of aphides.

German writers describe a species of aphis infesting plum trees in Germany, which seems to be identical with the English *Aphis pruni.* Köllar says that plum trees suffer much from this insect; and Taschenberg states that it caused great harm in 1869, and that thick lumps (*dicke Klumpe*) of larvæ were massed upon the stems and the young fruits ('Praktische Insekten-Künde,' von Prof. E. L. Taschenberg).

Professor Asa Fitch has given the name of *Aphis prunifolii* to an insect injuring plum trees in America. Mr Buckton thinks that it is a variety of the *Aphis pruni,* as its action and effects upon these fruit-trees are the same as those of the English species.

Life History. The *Aphis pruni* is a well-known species belonging to the genus *Aphis* of the numerous tribe *Aphidinæ,* according to the arrangement of Mr Buckton.

Early in the spring wingless (apterous) females, or large green lice, as they are termed by the labourers, are found upon the leaves of the plum and damson trees. These are the direct products of the eggs deposited upon the branches and stems of these fruit-trees in October. For the most part these larvæ, or lice, are pale green at first, becoming more dark green as they wax larger. Some specimens show a tinge of light brown.

These wingless females are viviparous, bringing forth living young like themselves, which reproduce their kind for many generations, nine according to Westwood, seven according to other entomologists, after the manner of aphides in general, without sexual coition. In due time, after the exhaustion of the generations, the pupa stage is reached. The pupa closely resembles the larva, at least to ordinary observers. But upon minute investigation the wing-cases can be seen, and the markings upon the upper part of the body are yellowish, and there are other slight distinctions.

From this pupa comes what is practically the perfect insect, the winged female of viviparous habit, light green in colour with black or dark markings upon the body, having widely extending hyaline or translucent wings, which convey it, wafted by the wind, to form new colonies in various places. Towards the end of the summer generations of winged males are produced. These are smaller as to their bodies than the viviparous females, and their wings are larger and more upright in form. In colour their bodies also show differences, being dark-coloured or brownish.

At the same time generations of wingless egg-laying (oviparous) females are evolved not quite so large nor of such a dark green colour as the original wingless viviparous female, the foundress of the race, or *Stammutter,* as the Germans call it; they are also without the peculiar mealy powder characteristic of her and of her immediate descendants.

Pairing takes place between these wingless females and the winged males. Little shiny black eggs are laid in October and fixed firmly by means of a glutinous substance upon the branches of plum and damson trees, in the rings of bark at the base of the bud-bearing twigs, as well as in the rings round the buds themselves. One may detect these eggs without a glass; they may be seen well with a small magnifier which every farmer, fruit grower, and market gardener should carry in his pocket, that he may be able to detect signs of coming 'blights' and other consequences of the onslaughts of insects.

Frost and cold have no effect upon these thick-skinned eggs. Scientific experiments have been made by Hunter, Spallanzani, and Boerhaave which demonstrated that the vitality of the eggs of insects was not destroyed by exposure to temperature ranging from 38° below zero to 15° F. ('A Monograph of British Aphides,' by G. B. Buckton). Experience also proves that larvæ are constantly hatched from eggs that have been exposed to the most severe frosts.

According to the weather is the time of hatching of the plum aphis eggs. It is, however, generally between the 1st and 18th of April. After about ten days the viviparous larvæ, the direct products of the eggs, bring forth the first generation of the workers of mischief.

Prevention. In small plantations, upon small-sized trees, and in gardens, it is practicable to remove the eggs which may be seen upon the branches by applying solutions of soft soap in water, made very adhesive by means of a considerable quantity of soft soap, to the stems and twigs infested, with stiffish hand-brushes.

Again, simply rubbing the infested bark with hard brushes, or with the hands encased in thick gloves, would be effectual in removing the eggs. These methods obviously involve a deal of labour and much expense, and therefore might be considered almost impracticable for adoption in large plantations.

Another mode of prevention would be to wash the trees that had been infested in the summer and upon which there were egg-laying females discernible in the early part of October, in order to prevent the deposition of eggs. It is quite clear that if these females are destroyed the sources of harm are cut off.

Remedies. The best and most efficacious as well as the most practical remedy is to syringe the infested trees when the blossoms have fallen and the young fruits are firm and independent. This process is comparatively simple and easy in grass orchards and in plantations where the trees are not too high or thickly set, and under the fruit bushes not too close together. It can be carried out

with the ordinary hop-washing engines so largely used in Kent, at all events for moderately sized trees. Where the fruit bushes are large and planted thickly it will be difficult to work these engines; in this case it might be found convenient to use hydronettes or small engines.

For washing plum and damson trees the best mixture is from 7 to 8 lbs. of soft soap, *unadulterated* soft soap it should be observed, to 100 galls. of water, to which should also be added the extract of from 4 to 5 lbs. of quassia chips.

It is believed that the new composition of petroleum and soft soap would be very effective in the proportion of from ½ to ¾ of a gall. of composition to 100 galls. of water.

It is desirable to wash plum trees and damson trees that are infested with aphides not merely to save the present crop, but also to prevent the serious injury that would be caused to the trees, and the consequent reduction in successive crops if the insects were left unmolested throughout the season ('Reports on Insects Injurious to Crops,' by C. Whitehead, Esq., F.Z.S.).

APHTHÆ. APHTHOUS ULCERS. MUGUET, Fr.; FASCH, Ger. White curd-like patches which form on the tongue in some states of debility and disordered digestion, especially in infancy and old age. The popular term Thrush includes true aphthous ulcers, and others produced by irritation of the alimentary tract.

Aphthous ulcers are due to a microscopic fungus (discovered by Gruby in 1842), to which he gave the name of Aphthaphyte or Cryptogame du muguet. Robin subsequently referred it to the genus *Oidium*, and gave it the name *Oidium albicans*. See THRUSH.

A'PIOL (-pe-ōle, or -ŏl). *Prep.* The soft alcoholic extract of parsley-seed is either digested or agitated for some time with ether; after sufficient repose in a cool place the ethereal solution is decanted, and the ether removed by distillation; the residuum is purified by solution in rectified spirit, and agitation first with a little litharge, and next with animal charcoal; after which the spirit is removed by distillation from the filtered solution.

Prop., &c. A yellow, oily, volatile liquid, having a peculiar smell and a highly disagreeable taste; soluble in alcohol, ether, and chloroform; insoluble in water; and coloured red by strong sulphuric acid. Sp. gr. 1·078. H. C. Whitney ('New Remedies,' 1880) states it is mainly essential oil of parsley with a little resin. In small doses it excites the pulse and nervous system; and in larger ones it causes headache, giddiness, vertigo, &c. It is said to be powerfully febrifuge, and has been highly extolled by MM. Joret and Homalle as a substitute for quinine in intermittents. It has also been found useful in intermittent neuralgias and the nocturnal sweats of phthisis.—*Dose*, 5 to 15 drops, in capsules.

APION APRICANS, Herbst. THE CLOVER WEEVIL. This weevil belongs to the family *Curculionidæ*, called Apion because of its pear-like shape, and is very destructive to clover, one of the most important farm crops.

There are two or three different species of Apions, all injurious to clover of various kinds; but their economy is practically the same, and the modes of attack and the treatment to be adopted are the same, so that it is only necessary to describe the typical species, viz. the *Apion apricans*.

The *modus operandi* of this insect is to bore into the seeds of clover and eat their contents. Heads of clover may often be seen decaying, looking rusty, and losing the flowers prematurely. Upon investigation they will be found quite devoid of seeds, and small punctures will be seen in the calyces which contain or have contained the larvæ.

Not only does this Apion do harm in this manner in its larval form, it also eats the leaves of the clover plant in its perfect or weevil shape. Complaints of the clover leaves being eaten by 'little black bugs' having been rife in parts of Kent as well as in other counties, examination was duly made, and it was plain that the sources of the evil were indeed little dark-coloured 'bugs,' Apion weevils. In the same fields they had eaten the clover to a serious extent in patches. It was the second cut, the first cut having been carried for seed. Upon looking at the heads of the seed clover it was found that many of these had not properly flowered, and showed clear signs of having been pierced by the larvæ of the Apions.

Life History. The weevil is hardly more than the eighth of an inch long. In colour it is a very dark blue, with the upper parts of its legs a yellowish-red colour. Its beak is very long indeed and slightly curved; it is terminated by strong jaws made for boring and biting. The weevils pair just before the clover blossoms, and the female lays her eggs within the blossoms—one at each place, it is believed. Larvæ, very small and of a dirty white hue, are soon hatched from these, and bore into that part of the calyx which is close to the ovary, and consume the embryonic seeds. They lie there curled up, turn to pupæ, and from this state at once become weevils, at least during the summer. At the end of the summer, when the clover heads have vanished, breeding ceases; then the weevils go to the ground and feed upon the leaves of the plants until the cold weather drives them to hiding-places in the earth. They may be found on the outsides of clover stacks, and round these, having been carried thither with the flower-stalks. It is supposed that it is only those that are on the outsides or a little way in the stalk that survive the heating process that takes place ordinarily in clover made into hay. In the case of clover cut for seed there is of course hardly any heat, and many weevils may be preserved in this manner.

Prevention. Badly affected clover intended for hay should be put into a silo, where the fermentation would effectually settle the larvæ. Both first and second cuts should be treated thus. Where seed clover is thrashed out all the refuse and flower heads knocked off should be burnt.

Remedies. There appears to be no remedy against these weevils when at work in clover heads. When they are discovered eating the clover plants in the autumn, feeding and folding sheep upon the leys would check them.

APION FLAVIPES, Kirby. THE DUTCH CLOVER WEEVIL. Another species of Apion—

A. flavipes—injures Dutch clover. Another—*A. livescerum*, or *A. onobrychis*,—sainfoin; and yet another, tares or vetches. The whole group of PAPILIONACEÆ, indeed, are very liable to injuries from this family of insects ('Reports on Insects Injurious to Crops,' by C. Whitehead, Esq., F.Z.S.).

A'PIS. [L.] The bee. In *entomology*, a genus of hymenopterous insects of the family *Anthoph'ila* or *Mellif'era*, section *Apia''riæ* (Latreille). The mouth has two jaws, and a proboscis infolded in a double sheath; the wings are four, the two foremost covering the hinder ones when at rest. The sexes are three—prolific females or queens, unprolific females or workers (commonly termed neuters), and males or drones. The females and working bees have a sting. The honey or hive bee is distinguished from the other species of this genus by having the femora of the posterior pair of legs furnished with a smooth and concave plate on the outer side, and fringed with hair, forming a basket or pocket for the reception and conveyance of the pollen of plants; and also in being destitute of spines at the extremity. The Linnæan genus includes nearly 60 species. See BEE.

Apis Mellif'ica, Linn. The honey-bee.

APLANAT'IC. In *optics*, applied as an epithet to lenses of which the figure, as well as the materials of which they are composed, is such that, with a given index of refraction, the amount of aberration, both chromatic and spherical, is insignificant, or the least that can be possibly obtained. See ABERRATION, ACHROMATISM, LENS, &c.

APLOTAXIS AURICULATA. Nat. Ord. COMPOSITÆ. A plant growing in the north-western Himalayas. It was first shown by the late Dr Hugh Falconer to be the source of the *Costus Arabicus* of the ancients, which Dr Royle had previously identified with the *Patchuck* or *Koot* root met with in the Indian bazaars. Dr Irvine states that formerly, when opium was not produced in Rajwarra, this root was extensively smoked as a stimulant. He adds that it is said to be a narcotic when thus used, and that formerly great quantities went to China for smoking purposes. It is chiefly used as a perfume, and for the protection of bales of cloth against insects.

APO-. [Gr.] In *composition*, from; denoting derivation, separation, opposition, or departure. It is a common prefix in words from the Greek, and is etymologically the same as the Latin *ab-*.

APOCYNIN (-pŏs'-e-nĭn). *Syn.* APOCYNINUM, L. A bitter glucoside found in *Apo''cynum cannabi'num*, Linn., or the Indian hemp of North America. It is soluble in water, alcohol, and ether. Powerful emetic and cathartic, likewise diuretic. Acts powerfully on the heart. Used in dropsy and Bright's disease. See ALKALOID.

APOGEE. In *astronomy*, that point in the moon's orbit which is furthest from the earth, or the point in the earth's orbit which is most distant from the sun. The word is also used as a general term to express the greatest distance of any heavenly body from the earth.

APOMORPHINÆ HYDROCHLORAS. *Syn.* HYDROCHLORATE OF APOMORPHINE. $C_{17}H_{17}NO_2HCl$. Small greyish shining acicular crystals, turning green on exposure to air. Soluble in about 35 parts water and 50 parts alcohol. Its solutions rapidly turn green, but do not thus lose their activity. With dilute solution of perchloride of iron it gives a deep red, and with nitric acid a blood-red coloration.

Uses. In large doses emetic, in small doses expectorant. In cases of poisoning it is of great value, and may be injected under the skin in doses of $\frac{1}{20}$—$\frac{1}{4}$ gr.—*Dose* as an expectorant, $\frac{1}{20}$ gr.

APOMORPHINE. *Syn.* APOMORPHINA. $C_{17}H_{17}NO_2$. An alkaloid obtained from morphine or codeine by heating in sealed tubes with hydrochloric acid. It was first prepared by Matthiessen and Wright. Introduce into a strong glass tube, closed at one end, 1 part of pure morphia and 20 parts of pure hydrochloric acid; these should not occupy more than one fifteenth of the tube. Seal the open end, and place the glass tube in another of cast iron, closed with a screw, and heat the whole in an oil-bath at a temperature between 140° and 150° C. during three hours. After cooling, the morphine has been converted into apomorphine, which can be purified as follows:

The tube is opened, and the liquid it contains diluted with water and neutralised by bicarbonate of soda; then, an excess of this salt being added, the apomorphine is precipitated with any morphia that may remain. The liquid is decanted, and the precipitate is exhausted with ether or chloroform, which dissolves the apomorphine only. To the ethereal or chloroformic liquor are afterwards added a few drops of hydrochloric acid to saturate the base. Crystallised apomorphine then separates spontaneously, and is deposited on the sides of the vessel. These crystals are washed rapidly with cold water, and purified by crystallisation from boiling water. The apomorphine can be obtained by precipitating a concentrated solution of this hydrochlorate by bicarbonate of soda; the precipitate is white, but turns green rapidly in the air. It should be washed with a little cold water, and promptly dried to avoid this alteration.

APOPLEXY. *Syn.* A STROKE; APOPLEXIE, Fr.; SCHLAG, Ger.

Definition. Loss of consciousness, of sensation, and of voluntary motion, more or less sudden in its onset, and due to a morbid state of the brain.

Conditions resembling apoplexy frequently result from causes acting directly upon the brain, such as defective or excessive supply of blood, or the presence in it of some poisonous material. Apparent apoplexy resulting from such causes is better described as an apoplectic state.

The apoplectic condition may be due—

(1) To the effect upon the brain of some poison circulating in the blood;

(2) To a sudden cerebral lesion, such as hæmorrhage or vascular obstruction;

(3) To a sudden shock or other impression arresting the cerebral functions, but causing no visible alteration in the brain (*Gowers*).

Apoplectic conditions appear in uræmic poisoning, drunkenness, and poisoning by narcotics. The most common cause of an apoplectic seizure is injury to the brain, which may occur from without or from within. External injuries, blows on the head, &c., may give rise to apoplexy by

simple concussion, by laceration of the brain, or by the rupture of blood-vessels and consequent effusion of blood, which clots and causes pressure upon the brain. Apoplexy generally arises, however, from within, and in a large majority of cases is the result of the rupture of a blood-vessel. A very small hæmorrhage is sufficient to cause apoplexy; it may also be due to embolism or thrombosis, which, by blocking the blood-vessels in some parts of the brain, deprives it of the necessary blood, and in this way either temporarily or permanently destroys the function of the affected area.

Apoplectic symptoms may occur without any obvious lesion of the brain, as in some cases of concussion; after epileptic fits; and the so-called 'simple apoplexy' which occurs in aged persons whose brains are atrophied, and occasionally in cases of Bright's disease. The nature of these cases is still very doubtful. It will be obvious that, in ordinary cases of apoplexy due to hæmorrhage, the nature and gravity of the symptoms as well as their duration will be very largely influenced by the amount of the extravasated blood and the seat of the hæmorrhage: thus the rupture of blood-vessels in certain parts of the medulla oblongata will stop the respiration and kill the patient in a few minutes; whilst effusion on the surface of the cerebral hemispheres may produce only partial paralysis and loss of consciousness, the symptoms passing away in a comparatively short time.

Symptoms. Dr Gowers describes them as follows: "The prominent feature of apoplexy is loss of consciousness without obvious failure of the heart's action. The onset is often instantaneous, so that the sufferer falls to the ground. The face may be flushed or pale; it is rarely very pale. The heart and arteries beat, often with undue force and lessened frequency. Respiration continues, but is laboured and stertorous, with flushing cheeks. The limbs are motionless. In severe cases no reflex action can at first be excited. The pupils may be dilated, contracted, or unchanged; in profound coma they are usually dilated; and they often vary in size spontaneously, being sluggish in their action to light. The patient can usually swallow, although often with difficulty. The sphincters permit the escape of urine and fæces, or the urine may be retained. In a case of moderate severity the reflex action soon returns, the conjunctivæ become sensitive, and the patient can be roused to exhibit some sign of consciousness, shows returning power of voluntary motion, opens his eyes when spoken to, and tries when told to do so to protrude his tongue. On the other hand, the apoplexy may continue and deepen in intensity, the patient dying at the end of a few hours or a few days. Death rarely occurs in a shorter time than two or three hours.

"Most commonly the symptoms of a local cerebral lesion are added to those of apoplexy; frequently such symptoms precede the loss of consciousness, unilateral weakness, deviation of the mouth, convulsion. They may be recognised during the attack; the limbs on one side exhibit more complete muscular relaxation than on the other; they fall more helplessly when raised; or there is unilateral rigidity or clonic spasm, varied in its seat; or irregularity of the pupils is observed, or rotation of the head, or conjugate deviation of the eyes. As the patient recovers these local symptoms become more and more distinct, the tongue deviates on protrusion, speech and swallowing are difficult, or the patient may have lost the use of language" (*Gowers*).

In cerebral apoplexy the body temperature usually falls slightly at first, but twelve to twenty-four hours after is succeeded by a rise.

Apoplexy may be distinguished from the unconsciousness of cardiac syncope by the feeble pulse, paleness of the face, and the sighing and irregular respiration present in the latter; in syncope also reflex action is but rarely abolished. It is sometimes extremely difficult to distinguish between apoplexy and some forms of blood-poisoning.

Treatment. Quiet is most important. The patient should be placed in a recumbent position, with the head a little raised. All tight clothing should be removed, especially about the neck. If the limbs are cold, hot applications, hot flannels, water-bottles, bricks, &c., should be used; and if the face is flushed, cold applications to the head are indicated. Mustard plasters on the neck and limbs will often promote the return of consciousness. Stimulants should be given with great care, and the state of the heart must be carefully watched, and any sign of failure attended to at once by the careful use of alcohol, ether, or ammonia. Bleeding is sometimes useful in cases of cerebral hæmorrhage. Purgatives are of service by reducing the amount of fluid in the blood, and thus relieving tension; croton oil appears to be the best, but they should not be used if there are signs of heart failure or if the surface of the body is very pale. See Drunkenness, Fainting, Opium Poisoning, Uræmia.

Robust, plethoric persons, with short thick necks, are universally accounted the most liable to apoplexy. In them the fit generally comes on without warning; and when once attacked with this malady they are especially liable to its recurrence. But it must be recollected that no particular constitution or temperament enjoys immunity from the attacks of apoplexy—a disease said to be more fatal among Englishmen than the natives of other countries. In Italy apoplexy is so dreaded that 'ti piglia un accidente'—may you die of an apoplexy—is a common form of objurgation.

Obs. A loss of consciousness exists alike in apoplexy, epilepsy, narcotism from opium and opiates, complete intoxication, and common fainting. These may be distinguished by observing that in epilepsy there are almost always convulsions, and more or less rigidity of the limbs, with (generally) foaming at the mouth and gnashing or grinding of the teeth, and frequently the utterance of noises often not unlike the barking of a dog; whilst stertor and laborious breathing, as a rule, are absent: in the stupor produced by opium, morphia, &c., the face is pale, calm, and perspiring, and the respiration is tranquil and without stertor; whilst the patient can, in almost all cases, be temporarily aroused to consciousness and kept awake by being made to walk between two attendants; the odour of opium or laudanum

is also frequently perceptible in the breath or ejected matter:—in the insensibility of INTOXICATION the pulse is usually feeble, and the patient may be temporarily roused by violent shouting in the ear, or by the application of nasal stimulants, particularly the common smelling-bottle (if strong); and the breath, and ejected matter (if any), smells of liquor:—in ordinary FAINTING the face and lips are pale, the breathing quiet, the pulse scarcely perceptible, the limbs mobile, and the fit lasts only a few minutes.

Treatment for Horses. Give in the first place a strong stimulant internally, and apply mustard embrocations to the belly and spine. Bleed, should the pulse be small and indistinct.—*In the parturient apoplexy of cows.* Bleed in the very earliest stage; give salts and croton; diluents; no solid food; let the body and legs be rubbed and clothed; great quantities of fluid should be avoided; use catheter; apply ice and refrigerants to head and neck; give frequent clysters of linseed gruel; remove milk every hour, and apply rubefacients to the spine; the animal should be well supported when down by bags of straw. Parturient apoplexy is a recurring disease, and a cow once affected should not be allowed to calve again (*Williams*).

Apoplexy, Splenic. See ANTHRAX.

APOSEP'EDIN (-dĭn). A substance found in putrid cheese, and supposed to be a product of the fermentation of caseine. Mulder and others have shown that it is merely impure leucine.

AP'OSTEME† (-tēme or -tĕm). *Syn.* AP'OSTEM†; APOSTE'MA†, L. An abscess or collection of purulent matter in any part of the body.

APOZEME. An old name for a decoction. It came into English use from the French and Latin, and originally from the Greek ἀποζήειν, meaning to boil away.

APPARA'TUS. [L., Eng.; class. pl., appara'tus.] *Syn.* APPAREIL, Fr.; APPARAT, GERÄTHSCHAFT, Ger. In technical language, the instruments, utensils, and mechanical arrangements employed in any operation, experiment, or observation, or in any art or trade. In *anatomy* and *physiology*, a catenation of organs all ministering to one general purpose or function; as the digestive apparatus, respiratory a., &c.

APP'ETITE. *Syn.* APPETI'TUS, L.; APÉTIT, Fr.; APETIT, BEGIERDE, ESSLUST, Ger. The natural desire of gratification, whether corporeal or mental. In *physiology*, the instinctive inclination to perform certain natural functions, as those of digestion and generation; but appr., the natural desire for food. In *psychology* and *philosophy*, the APPETITES (pl.) are affections of the mind directed to general objects, as fame, glory, or riches; these, when subsequently turned to particular objects, constitute the PASSIONS, as envy, gratitude, revenge, or love. In its common and unqualified sense the word appetite is confined to the desire for food, and in that sense chiefly concerns us here.

The sensations of hunger and thirst are well understood, and their recurrence at proper intervals is a necessary consequence of vital action, and is essential to the existence of the body in a state of vigour and health. Any alteration from their normal condition indicates diseased action of the stomach, or of the nervous system or circulation; or it may result from vicious habits. A healthy appetite for food is usually a most certain indication that nature requires a supply; but in the indulgence of this appetite certain regulations should be observed, and a boundary should be put to mere animal gratification. By slowly eating and thoroughly masticating the food, the stomach becomes gradually and equally distended, and the individual feels himself satisfied only after he has taken a quantity sufficient for the nourishment of his body; but, on the contrary, if the food be swallowed rapidly, and without proper mastication, it presses heavily and roughly against the sides of the stomach, and induces a sensation of fulness before a sufficient meal has been made. The consequences are, that hunger soon returns, and the individual must either have recourse to food between the usual time of meals, or suffer the consequences of imperfect nutrition. Exercise and labour, within certain limits, promote the healthy functions of the stomach and bowels, through the action of the muscles of the abdomen increasing the peristaltic motion of these viscera. An inordinate appetite in persons leading a sedentary life is generally indicative of the food passing off imperfectly digested, or of dyspepsia. More food is required in winter than in summer, in consequence of the greater radiation of heat from the body; and hence the increased appetite which is usually an accompaniment of that season. In persons who lead a more sedentary life in winter than in summer, either no change of this kind occurs, or the reverse is the case; the want of exercise producing a diminution of appetite corresponding to the increase of it that would otherwise result from the seasonal change of atmospheric temperature, or even greater. Deviations of the appetite from the healthy standard, or the normal condition, constitutes DEFECTIVE or DISEASED APPETITE.

Deficiency or loss of appetite (AN'OREXY; ANOREX'IA, L.) generally arises from disordered stomach; but is also frequently symptomatic of other affections, particularly dyspepsia, biliousness, feverishness, and organic diseases of the lungs, stomach, and primæ viæ. It is a common consequence of sedentary life, and of extreme mental anxiety, excitement, or exhaustion. The *treatment* will necessarily vary with the cause. In simple spontaneous cases the appetite may generally be improved by outdoor exercise, and the occasional use of mild aperients, especially salines and aloetics. With heavy drinkers a gradual reduction of the quantity of the strong liquors usually consumed is generally followed by a restoration of the appetite and digestive powers. The change thus gradually effected in the course of eight or ten days is often almost magical. The excessive use of liquors—especially of spirits, wine, or beer, or even of warm weak ones, as tea, coffee, soup, &c.—is always prejudicial. Hence drunkards are particularly subject to defective appetite; and teetotalers and water-drinkers to a heartiness often almost approaching voracity. See BILE, DYSPEPSIA, &c.

Depraved appetite (PI'CA, L.), or a desire for unnatural food, as chalk, cinders, dirt, soap, tallow, &c., when an idiopathic affection, or when

depending on vicious tastes or habits (as is often the case in childhood), may be treated by admixing very small doses of tartar emetic or ipecacuanha with the objectionable food or articles. When symptomatic of pregnancy, a plentiful and nutritious diet, including the red meats, with a little good malt liquor or wine, may be adopted with advantage. When symptomatic of chlorosis, to this diet may be added the use of chalybeate tonics, and sea or tepid bathing; when of dyspepsia, a light diet, bitter tonics, free exercise, fresh air, and cold bathing, will generally effect a cure.

Insatiable appetite (CANINE APPETITE, VORACITY; BULIM'IA, L.) is generally symptomatic of pregnancy, or worms, or diseases of the stomach or the viscera immediately connected with it; but sometimes exists as a separate disease, and is even said to be occasionally hereditary. When it occurs in childhood, worms may be suspected, and vermifuges administered. In adults, a common cause is imperfect digestion, arising from stomach complaints or gluttony, when the languor and gnawing pains of disease are mistaken for hunger. In this case the diet should be regulated and the bowels kept gently relaxed with mild aperients, and tonics (as bark and steel) or bitters (as orange-peel and gentian) may be administered. When pregnancy or vicious habits are the cause, the treatment indicated under DEPRAVED APPETITE may be adopted. When the affection is occasioned by acidity in the stomach, an emetic, followed by the moderate use of absorbents or antacids, will generally effect a cure. In those cases depending on a highly increased power of the stomach in effecting rapid and complete digestion, its contractile force and morbid activity may be often allayed by the copious use of salad oil, fat meat, &c., by the cautious use of opiates, or by the use, or freer use, of tobacco (either smoked or chewed, or both). See BILE, DYSPEPSIA, WORMS, &c.

Appetite is to some extent a habit; thus persons accustomed to dine punctually at a certain hour will feel a desire for food at that hour, even though they may at an earlier part of the day have had an ample meal. In these cases a very small quantity of food, such as a dry biscuit, will suffice to allay the craving. To persons obliged to lead very sedentary lives, the habit of eating at regular intervals, and in reasonable quantity, is one the importance of which cannot be too strongly insisted on, and should be regarded as a duty. Those who cannot eat cannot work, and mere disinclination for food should be conquered, or it may lead to great misery and discomfort.

APP'LE (ăp'l). *Syn.* MA'LUM, PO'MUM, L.; POMME, Fr.; APFEL, Ger.; APPLE, Dut.; MELA, Ital.; APLE, Swed. This well-known fruit is the product of the cultivated varieties of *Pyrus malus*, Linn., or the crab-apple of our hedges, a tree of the Nat. Ord. ROSACEÆ. The date of its amelioration from the wild state is probably very remote, as several kinds are noticed by Pliny in a manner that would lead to the inference of a high antiquity. Pippins, or 'seeding improved apples,' are said to have been introduced into this country from the South of Europe towards the end of the 16th century. Don enumerated 1400 varieties of the cultivated apple; there are now probably above 1650. Rennet apples (POMA RENETTIA) are those ordered in the P. Cod. to be used in pharmacy. In *botany* and *composition*, the term apple (POMUM) is used to designate any large, round, fleshy fruit, consisting of a 'pericarp,' enclosing a tough 'capsule' containing several seeds; as love-apple, pine-apple, &c.

The wood of the apple tree is much used in turnery; that of the crab tree is generally preferred by millwrights for the teeth of mortise-wheels.

The expressed juice of 1 *cwt.* of ripe apples, after the free acid has been saturated with chalk, yields from 11 to 13 *lbs.* of a very sweet but uncrystallisable sugar.

Apples have been analysed by Fresenius, and were found to have the following composition:

SOLUBLE MATTER—	
Sugar	7·58
Free acid (reduced to equivalent in malic acid)	1·04
Albuminous substance	0·22
Pectous substances, &c.	2·72
Ash	0·44
INSOLUBLE MATTER—	
Seeds	0·38
Skins	1·44
Pectose	1·14
[Ash from insoluble matter included in weights given]	[0·13]
Water	85·04
	100·00

Acid of Apples. Malic acid.

Love'-apple‡. The tomato. POMODÓNO, Ital. See TOMATO.

Mad'-apple‡. The larger Mecca or Bussorah gall. Also called DEAD SEA APPLES, A. OF SODOM, &c. See GALLS.

Oak-apple. See GALLS.

Apple, Alligator. *Anona palustris*, L. A small tree abundant on marshy shores in Jamaica; the fruit, said to be narcotic and even poisonous, is eaten by alligators as it drops; the wood, known as cork wood, is used for stopping bottles and lining boxes.

Apple, May, or Podophyllum Roots. *Podophyllum peltatum*, L. A perennial, common in moist woods, in the United States and Canada. The roots or rootstocks are collected about August, when the principle is most active, and thoroughly dried. They are bitter and acrid, and furnish the medicine known as Podophyllin, q. v.

Apples, Rose. The fruits of *Myrtus jambosa*, L., a small tree of India, and cultivated in many tropical countries. The tree is planted for hedges, shade, and ornament, as well as for the sake of the fruits, which have a fragrance similar to rose water, but a very insipid taste. They are usually about the size of a small apple, but vary in colour, some being white, others rose-pink. Candied rose apples, preserved with sugar, are articles of commerce.

A decoction of the bark is used as an astringent in dysentery. A. W. Gerrard obtained from the bark a neutral crystalline body (jambosin), having the formula $C_{10}H_{15}NO_3$.

Apple, Star. The fruit of *Chrysophyllum cainito*,

L., a native of the West Indian Islands and South America.

Apple, Wood. *Feronia elephantum,* Corr., a large Indian tree. The pulp of the fruit is acid, and is made into a jelly. A gum similar to gum arabic is exuded by the tree, and the wood is used in house-building, for agricultural implements, &c.

APPRENTICESHIP. The essence of the agreement between master and apprentice is the undertaking by the master to teach the apprentice his business; and herein lies the distinction between a contract of apprenticeship and an ordinary contract of hiring and service. It was formerly the law that the word 'apprentice' (APPRENDRE, Fr.) must be used in the contract, but it has now been decided that no technical word is necessary if the intention of the contracting parties is manifest on the face of the instrument; but it is essential that it should appear that the primary object of the indenture is the *instruction* of the apprentice. Generally speaking, an infant cannot enter into a contract, but he is at liberty to bind himself apprentice because the contract is for his benefit, though he may repudiate the contract on attaining his majority. Though not essential, it is *usual* for the parent or guardian of the infant to join in the deed and covenant that the apprentice shall carry out its provisions, as, except under 'the custom of London,' the apprentice himself cannot be sued for their breach. Unless specially stipulated for, if a boy goes on trial, or the proposed apprenticeship falls through on other grounds, the master cannot recover for board and lodging, as the law is zealous to prevent a master obtaining the services of an infant without any corresponding benefit to the infant; the essence of a contract being its 'mutuality.'

Forms of apprenticeship indenture are obtainable at the law stationers, but in the interests of both parties it is desirable to consult a competent solicitor, as almost the whole of the litigation concerning the law of apprenticeship has arisen from the absence of the legal mind in the drawing of the indentures. It was formerly the practice to insert in the indenture a covenant by the apprentice that he would not play cards, frequent public-houses, or enter into matrimony, but as a rule the last is now only inserted. An indenture of apprenticeship should contain three provisions: first, the binding of the apprentice; secondly, the covenants by the apprentice and by his father or guardian if they join in the deed; and thirdly, covenants by the master to teach the apprentice his business, and to board and lodge him, &c., as the case may be. The deed ought also to show whether the apprenticeship is to terminate on the death of the master, or whether it will continue with his personal representatives after his death if they continue the business, or with the person to whom the business may be transfered. To render the deed valid the premium must be truly stated therein, and the deed must be properly stamped, the duty being where there is no premium 2*s*. 6*d*., and in other cases 5*s*. for every £5 or fractional part of £5, and is usually paid by the parent or guardian.

The indenture of apprenticeship should be always executed in duplicate, the master holding the original and the parent or guardian the counterpart. The latter requires a 5*s*. stamp, and should also have a denoting stamp to show that the original is properly stamped. If the original be not forthcoming the duplicate is receivable in evidence. Where one copy only is executed, the master is entitled to its custody. At the termination of the apprenticeship the original must be handed to the apprentice and the counterpart to the master. The apprentice being bound, it is the duty of the master to teach him his business, and inability on his part to do so would justify the voiding of the indenture. In the absence of any stipulation in the contract, the death of the master puts an end to the apprenticeship, and the master may terminate the apprenticeship where the apprentice is permanently incapacitated by illness, or is an habitual thief, or has been convicted of felony. Unless provided in the indentures, the return of a premium or a part thereof cannot be claimed except in the case of the death of the master.

Under the old Bankruptcy Acts the bankruptcy of the master put an end to the apprenticeship, but section 41 of the Bankruptcy Act of 1883 provides that where, at the time of the presentation of the bankruptcy petition, any person is apprenticed to the bankrupt, if either the bankrupt or the apprentice give notice in writing to that effect to the trustee, the adjudication of bankruptcy shall annul the indenture; but the trustee is at liberty, on the application of the apprentice, to transfer the indenture to some other person. An apprenticeship can also be put an end to by the mutual consent of all parties concerned. Mere disobedience by the apprentice of the orders of his master is not, in the absence of provision in the contract, sufficient to put an end to the apprenticeship; but it has been held that where the contract provided that the apprentice should obey all orders during business hours, and failed to do so, his master was entitled to dismiss him, and the same applies if his own misconduct be such as to prevent the master teaching him his business. An outdoor apprentice cannot be compelled to attend at new business premises less convenient of access than those in use at the time of the apprenticeship. The parent or guardian who covenants for the due performance of the deed cannot be sued by the master unless the conduct of the apprentice be such as to cause him actual damage; but a master is entitled to bring an action against any person detaining his apprentice, knowing him to be such, or he may waive the 'tort' and sue the party who employs his apprentice for work done. The master is also entitled to bring an action where such injury has been done to his apprentice as to incapacitate him for business.

Under the Employers and Workmen's Act, 1875, any dispute between an apprentice, *to whom the Act applies*, and his master, incidental to their relation as such, may be determined by a court of summary jurisdiction, and the court shall have the same power as if the dispute were between an employer and a workman, and the master were the employer and the apprentice the workman, and the instrument of apprenticeship a contract between an employer and a workman. The court

may also order the apprentice to perform his duties under the apprenticeship, or rescind the instrument of apprenticeship, and in doing so order the whole or any part of the premium to be refunded. An apprentice failing to comply with the order of the court may be imprisoned for a period not exceeding fourteen days. Where there is any person liable under the instrument of apprenticeship for the good conduct of the apprentice, the court may direct that person to attend any proceedings before them, and may order him to pay damages for any breach of the contract of apprenticeship to an amount not exceeding the limit, if any, to which he is liable under the instrument of apprenticeship. The court may also, instead of inflicting any punishment on the apprentice for breach of his agreement, accept security for his good conduct from any person willing to be bound. The power of courts of summary jurisdiction is limited in these cases to £10, and where a greater amount is involved proceedings by civil action must be taken either in the County Court or in the High Court against the father or guardian to recover damages for breach of the stipulations in the deed. It only remains to add that of late years, especially in the north of England, the custom of apprenticeship has to a considerable extent died out, owing to the greater freedom which the absence of the indenture of apprenticeship gives to the master to discharge his servants.

A′PRICOT. *Syn.* A′PRICOCK†; ARMENI′ACUM MA′LUM, PRÆCO′TIUM, L.; ABRICOT, Fr.; APRIKOSE, Ger. The fruit of *Armeniaca vulgaris*, Lamb. (*Prunus armeniaca*, Linn.), a rosaceous tree indigenous in Armenia, Cashmere, &c., and now cultivated in every temperate region of the world. Under the name of Præcox it was known in Italy in the time of Dioscorides; but it was not introduced into England until the reign of Henry VIII (A.D. 1540). Its cultivation has since been zealously attended to by our gardeners, and it is now one of the choicest and most esteemed of our wall-fruits, and is particularly valued for desserts. It is reputed to be nutritious, easy of digestion, laxative, and stomachic. The seeds are bitter and saponaceous.

Apricots are principally eaten as gathered; but are also dried, candied, and made into jam. In *confectionery*, the Brussels and Breda varieties are preferred to the larger and sweeter kinds. See FRUIT, PRESERVES, &c.

Apricots, Briançon′. The fruit of *Armeniaca brigantiaca*, Pers. Acidulous; seeds or kernels, by expression, yield HUILE DE MARMOTE.

Apricot fruits (*Prunus armeniaca*) dried form an important article of food in north-west Himalaya. Oil for lamps, cooking, &c., is expressed from the kernels. Flat cakes of compressed apricot pulp are sold in the bazaars at Damascus.

The natives of Ladakh (Cashmere) use apricot wood for making shovels and pestles for crushing rice.

APRON, WASHING, for infants, should be made of good thick flannel—that known as bath-coating is best. It should be made long and full, and well dried before use.

A′QUA (-kwă). [L.] Water. AQUA DESTILLA′TA or A. DISTILLA′TA, is distilled water; A. FLUVIA′LIS or A. EX FLU′MINE (-ĭn-e), river water; A. FONTA′NA, spring water; A. MARI′NA or A. MA″RIS, sea water; A. MINERA′LIS, mineral water; A. NIVA′LIS or D. EX NI′VE, snow water; A. PLUVIA′LIS, A. PLU″VIA, or A. IM′BRIUM, rain water, soft water; A. PUTEA′NA or A. EX PU′TEO, well, pump, or hard water. In *chemistry* and *pharmacy*, this word was formerly applied to numerous preparations and articles now included under other heads. See EAU, ESPRITS, HAIR-DYES, LIQUORS, SOLUTIONS, WATERS, &c.

Aqua Amarella. A compound for hair-dyeing; is prepared with sugar of lead, common salt, and water.

Aquafor′tis. [L.] Literally, 'strong water;' the name given by the alchemists to the acid obtained by distilling a mixture of nitre and sulphate of iron. The word is still commonly employed by mechanics and artists to designate the impure fuming nitric acid of commerce, and is thus also retained in trade. By these concentrated nitric acid is called 'spirit of nitre.' 'Double aquafortis' merely differs from the other in strength. See NITRIC ACID.

Aqua Græ′ca, A. Orienta′lis. See HAIR-DYES.

Aqua Mari′na. [L.] The beryl†.

Aqua Mirab′ilis†. [L.] Literally, 'wonderful water;' a cordial and carminative spirit distilled from aromatics, and formerly reputed to possess many virtues.

Aqua Re′gia. [L.] Nitrohydrochloric acid; originally so called, by the alchemists, from its power of dissolving gold.

Aqua Toffa′nia. [L.] See ACQUETTA.

Aqua Vi′tæ†. [L.] Literally, 'water of life;' a name familiarly applied to the leading native distilled spirit. Thus, it is whisky in Scotland, usquebaugh in Ireland, geneva in Holland, and eau de vie or brandy in France. When the term is employed in England, French brandy is understood to be referred to. See ALCOHOL, &c.

Aqua Vitæ Aromatico-Amara (*F. Bolle*, formerly *J. B. Claude*, Berlin). Galangal, ginger, āā 2 parts; orange berries, European centaury, gentian, cinnamon, angelica, āā 1 part; alcohol, 30 parts; water, 26 parts. Digest and filter (*Hager*).

AQUARIUM. A tank or vessel made of glass, containing either salt or fresh water, and in which either marine or fresh-water plants and animals are kept in a living state. In principle, the aquarium depends upon the interdependence of animal and vegetable life. The carbonic acid evolved by the animals is decomposed under the influence of solar light by the plants, and the oxygen necessary for the maintenance of the life of the animals is thus eliminated, whilst the carbonic acid essential to the existence of the plants is supplied by the animals. The aquarium, therefore, must be stocked both with plants and animals, and for the welfare of both something like a proper proportion should exist between them. But even under these conditions the water should be frequently aërated, whether the aquarium contains fresh or salt water. This may be done by simply blowing through a glass tube which reaches to near the bottom, or, still better, in the following manner:—Take a glass syringe which can be easily worked. Having filled it with

water, hold it with the nozzle about two inches from the surface of the water in the aquarium, into which the contents are to be discharged quickly and with a sort of jerk. By this means a multitude of small bubbles are forced down into the fluid. This operation should be several times repeated. A simpler method is to take out a portion of the water from the aquarium and to pour it back again from a height. When, as not infrequently happens, the aquarium is provided with a fountain, this of course ensures a continual change of water; but even where this is the case the joint presence both of plants and animals is advantageous to the health of both. When sea water cannot be procured for the marine aquarium a substitute for it may be made as follows:—Mix with 970,000 grains of rain water 27,000 grains of chloride of sodium, 3600 of chloride of magnesium, 750 of chloride of potassium, 29 of bromide of magnesium, 2300 of sulphate of magnesia, 1400 of sulphate of lime, 35 of carbonate of lime, and 5 of iodide of sodium. These all being finely powdered and mixed first, are to be stirred into the water, from which a stream of air may be caused to pass from the bottom until the whole is dissolved. On no account is the water to be boiled, or even to be heated. Into this water, when clear, the rocks and seaweed may be introduced. As soon as the latter are in a flourishing state the animals may follow. Care must be taken not to have too many of these, and to remove immediately any dead ones. The loss that takes place from evaporation is to be made up by adding clear rain water. The presence of a number of molluscous animals, such as the common periwinkle, is necessary for the consumption of the vegetable matter continually given off by the growing plants, and of the multitudinous spores, particularly of the confervæ, which would otherwise soon fill the water, rendering it greenish or brownish, and turbid. In a fresh-water aquarium the bottom should be covered with a layer of fine sand and shingle, and in this the weeds should be planted. The best for this purpose are *Vallisneria spiralis*, *Anacharis*, and *Chara vulgaris*. A few water-snails should also be put in; the best are *Planorbis*, *Paludina*, and some of the smaller species of *Limnæa*. The large *Limnæa stagnalis* should be avoided, except in very large aquaria, as, though excellent scavengers, they are somewhat too voracious and destructive. One plant and two or three snails should be used for each gallon of water put into the aquarium.

It is by no means necessary for the purpose of study to have a large and costly aquarium; on the contrary, a number of smaller ones are for scientific purposes far more satisfactory. Bell-glasses, securely set upside down in a block of wood; wide-mouthed glass jars, and even an ordinary tumbler will serve many purposes for which a large tank is quite unsuited; a few stones and clean sand or mud (provided it does not contain too much animal or vegetable *débris*) should be placed at the bottom, and a small piece of *Anacharis* or *Vallisneria* planted in it; the vessel is then placed in a good uniform light (not in direct sunlight), and left until the plant has established itself. This done, and a number of these small aquaria having been prepared, it is possible to study the growth and development of individual organisms. Young mollusca can be grown from spawn with the greatest ease, and the characters of the young of various species easily studied—for rotifers, desmids, and microscopic organisms a large test-tube on a foot answers very well; and by adopting this plan of separation much time and trouble is saved in the study of particular organisms. The water must be renewed as required, and the dust kept out by a piece of coarse muslin, which for these smaller vessels may be conveniently attached to a ring of wire and dropped over the mouth of the tube or bottle.

AQUATINT'A. [L., Fr.] *Syn.* A'QUATINT, Eng.; ACQUATINTA, It. A species of etching on copper, producing an effect resembling a drawing in Indian ink.

A'QUEDUCT. WASSERLEITUNG, Ger.; AQUEDUC, Fr.; AQUEDOTTO, It. A conduit for water. Though strictly applicable to any artificial system for conducting water from one place to another, the term is generally used only of the main trunk of such a system, viz. the one which conveys the water from its source to the centre in which it is to be distributed. The aqueducts of the Roman Campagna, constructed at various periods from about 200 B.C. to the first or second century of the Christian era, for the supply of the city of Rome, are amongst the most remarkable structures of the kind in the world, not only from their great size and length, but as engineering works. The Romans did not use filter-beds, but by constructing towers on the aqueducts at intervals, subdivided internally into several chambers or settling tanks, through which the water had to pass before it re-entered the main channel, the sand and mud were deposited and the aqueduct kept clean.

A'QUEOUS (-kwe-). *Syn.* AQUOSE'*; A'QUEUS, AQUO'SUS, L.; AQUEUX, Fr.; WÄSSERIG, WÄSSERHALTIG, Ger. Watery; made with, containing, or resembling water. In *chemistry* and *pharmacy*, applied to solutions, extracts, &c., prepared with water.

AR'ABESQUE (-bĕsk). [Fr.] In the Arabian manner; more particularly applied to a species of capricious, fantastic, and imaginative ornamentation, consisting of foliage, stalks, plants, &c., to the entire exclusion of the figures of animals. The designs of this class, now so much employed in cloth and leather binding, are produced by the pressure of hot plates or rollers having the pattern engraved on them. See MORESQUE.

AR'ABIN (-bĭn). $C_{12}H_{22}O_{11}$. [Eng., Fr.] *Syn.* SOLUBLE GUM; ARABI'NA, L. The pure soluble principle of gum acacia.

Prep. Dissolve white gum arabic in a little pure water, then add some hydrochloric acid; filter the solution, and add alcohol as long as it produces curdiness; collect the precipitate, and dry it by a gentle heat.

Prop., &c. Very soluble in water; basic acetate of lead, alcohol, and ether precipitate it from its solutions. It is isomeric with crystallised cane sugar. It possesses no practical superiority over the best gum arabic except its paler colour.

AR'ABLE (-ăbl). *Syn.* ARAB'ILIS, L.; ARABLE, LABOURABLE, Fr.; PFLUGBAR, URBAR, Ger.

In *agriculture,* fit for or under tillage or aration; ploughed.

Arable Land. In *agriculture,* land which is chiefly or wholly cultivated by the plough, as distinguished from grass land, woodland, common pasture, and waste. See LAND, SOILS, &c.

ARACHIS HYPOGÆA. [L.] *Syn.* GROUND-NUT PLANT. An annual herb extensively grown in warm climates as an important article of food, and for the sake of its oil, which is largely used as a substitute for olive oil; also by perfumers in pomades, cold cream, &c. Its value as an oil was first recognised in Europe about 1840. Its native country is doubtful, but it is probably of American origin. Remarkable from the plant, after flowering, forcing the young pods underground, where they ripen.—*Officinal Part.* The oil of the seeds (Oleum Arachis, Ground-nut Oil). Obtained by expression. Limpid, clear, light yellow, almost inodorous, or with a faint smell and bland taste. Sp. gr. 0·916.—*Prop. and Uses.* The following notice, by Dr Tuson, appeared in the 'Veterinarian' for October, 1876:

"Having in the course of my analytical practice had occasion to examine some samples of Marseilles earth-nut cake, I take the opportunity of communicating the results obtained, in the hope of furnishing interesting information respecting a material which is chiefly employed in the sophistication of the more expensive feeding cakes, but which I think might in some instances be with advantage substituted for them.

"Arachis seeds constitute one of the varieties of food termed pulse, and the oil which exists in them to the extent of from 40% to 50% is rapidly being introduced in the making of soap in this and other countries. It is an article also of the Indian Pharmacopœia.

"By pressure the seeds yield all but about 7% of their oil, and the material which remains after the expression of the greater part of the oil is sent into commerce as earth-nut or ground-nut cake.

"Sometimes the husks of the seeds are first removed, and only the kernels subjected to pressure for the sake of the oil; the cake so produced is called 'decorticated earth-nut cake:' at other times the entire seeds are subjected to this treatment, and then the resulting cake is known as 'undecorticated earth-nut cake.'

"The following table shows the composition in 100 parts of both descriptions of cake, as well as that of linseed cake of first-rate quality; the last analysis being added for the sake of comparison:

Table showing the Centesimal Composition of Decorticated and Undecorticated Earth-nut Cake and Linseed Cake.

	Decorticated Earth-nut Cake.	Undecorticated Earth-nut Cake.	Linseed Cake.
Moisture	9·58	9·28	11·72
Fat and heat producers { Oil	7·40	6·99	12·00
Fat and heat producers { Starch, digestible fibre, &c.	27·63	23·66	25·29
Flesh-formers (albumenoids)	42·81[1]	32·81[2]	32·64
Indigestible fibre	7·87	23·80	11·79
Ash	4·71	3·45	6·47
	100·00	100·00	100·00

[1] Containing 6·85 of nitrogen. [2] Containing 5·25 of nitrogen.

"From the foregoing analysis it will be seen that both descriptions of earth-nut are exceedingly rich in flesh-formers, and that they contain a moderately large amount of oil. They also possess a sweet agreeable flavour, and are, I believe, very digestible. As these may, I am informed, be bought at from £6 to £8 per ton, it is evident that farmers would do well to give earth-nut cakes a trial in the feeding of their stock.

"Pure linseed cake does not contain starch, but in its stead mucilage. The feeding qualities of starch and mucilage are, however, very similar."

ARALIA (FATSIA) PAPYRIFERA, Bth. A tree of Formosa, the pith of which is used in the preparation of rice paper. The pith is cut into cylinders and then sliced with large knives. The paper is made into bundles, 100 squares of about 2½ in. × 3 in. being sold for about 1¼*d.* or 1½*d.*

Aralia Nudicaulis, L. The climbing stem of this plant constitutes Virginian sarsaparilla, and is used medicinally in the United States.

ARAR WOOD (*Callitris quadrivalvis,* Vent.). An Algerian tree. It is the citron or thyme wood highly prized by the Romans. The stems are frequently burnt off by the Arabs, and the roots consequently become large and knotted, producing an intricately mottled grain much appreciated in cabinet work.

ARAROBA. *Syn.* CHRYSAROBIN, ARAROBA POWDER, BAHIA POWDER, GOA POWDER. The medullary matter of the stem and branches of a leguminous tree, *Andira araroba,* growing in Brazil. The plant from which araroba is extracted is a large intertropical tree 80 to 100 ft. high. It is supposed that the araroba is formed by the oxidation of resin which exists in great abundance in the tree. Its colour when fresh varies from a pale primrose to orange; by exposure to air it darkens to brown or purple. The commercial article is very variable, often mixed with small chips of wood, yielding to hot benzole 20% to 80% of a crystalline body called chrysarobin, which by exposure to air oxidises to chrysophanic acid. It is in extensive use amongst the natives of India, who employ it in affections of the skin. It has been applied with success in shingles and ringworm, in the form of ointment made as follows:

Araroba in powder	20 grains.
Acetic acid	10 drops.
Benzoated lard	1 ounce.

Dr Attfield found the powder to contain from 80% to 84% of chrysophanic acid, to which substance its remedial powers are doubtless due. It is now the chief source of this acid.

ARA'TION*. In *agriculture,* ploughing; cul-

ture by ploughing; tillage. Lands in a 'state of aration' are those under tillage.

AR'BOR. [L.] A tree. The seventh family of vegetables in Linnæus's system. In *anatomy* and *chemistry*, a term formerly applied to membranes and structures having some real or fancied resemblance to a tree or vegetation; *e. g.* the *Arbor vitæ cerebelli*, a name given to the appearance presented by the cerebellum as seen in section. An ar'boret is a little tree; an arborist, or ar'borător†, is one who studies or cultivates trees.

ARBUTIN. $C_{25}H_{34}O_{14}$. A crystalline glucoside obtained by Kawalier from the leaves of the red bearberry, *Arctostaphylos uva-ursi*, and by Zwenger and Himmelmann from the leaves of a species of winter-green, *Pyrola umbellata*. It is prepared by precipitating the aqueous decoction of the leaves of either of these plants with basic acetate of lead, filtering, removing the excess of lead with sulphuretted hydrogen, and either treating the filtrate with animal charcoal and leaving it to crystallise, or evaporating and digesting the residue with a mixture of 8 parts of ether and 1 part of alcohol, which dissolves out the arbutin, and deposits it on evaporation in the crystalline state.

Arbutin taken internally is decomposed with production of hydroquinone, the urine of the patient changing to a brown or olive-green colour. It is given in chronic cystitis and vesical catarrh. —*Dose*, 15 to 60 grs.

ARCA'NUM. [L.] *Syn.* ARCANE, Fr.; GEHEIMNIS, Ger. A secret. In *alchemy*, a term applied to various preparations without any precise meaning. "Arcanum is a thing secret, incorporeal, and immortal, which can only be known to man by experience; for it is the virtue of each thing, which operates a thousand times more than the thing itself" (*Ruland*). In *ancient medicine* and *pharmacy*, a nostrum. The word is still occasionally used in the plural (ARCA'NA, secrets, mysteries) in the titles of books; as, 'Arcana of Chemistry,' a book professing to contain a full exposition of the mysteries of that art.

Among the old chemists, ARCANUM AL'BUM was 'pulvis Viennensis albus virgineus' (see POWDERS); A. BEC'CHICUM, a sweetened aqueous solution of liver of sulphur; A. CORALLI'NUM, red oxide of mercury that had been digested in a solution of potash, washed with water, and then had spirit of wine burnt on it (once a favourite mercurial and escharotic); A. DUPLICA'TUM, sulphate of potash; A. D. CATHOL'ICUM, roots of colchicum and plantain (worn as an amulet against fevers and pestilential diseases); A. LUDEMAN'NI, oxide of zinc; A. TAR'TARI, acetate of potassa; A. VITÆ, elixir vitæ; &c.

ARCHE'US (-kē'-ŭs; är'-*—*Mayne*). [L.] *Syn.* ARCHÆ'US, L. A term invented by Paracelsus, and employed by the alchemists and older physicians to imply the occult cause of phenomena, as well as the sub-causes or agents by which the effects were accomplished. Van Helmont and Stahl ascribe certain vital functions to the influence and superintendence of a 'spiritus archæus,' or intelligent vital principle. According to others, the powers of 'Archæus' were indefinitely extended. He or it was an occult power of nature, the artificer of all things, physician-general to the universe, &c. &c., to the utmost bounds of absurdity and confusion.

From this word comes the adj. ARCHE'AL or ARCHÆ'AL, hidden, operative.

ARCH'IL (artsh'-ĭl). *Syn.* ARCH'EL*, OR'CHIL; ARCHIL'LA, ORCHIL'LA (ch as k), L.; ORSEILLE, Fr., Ger.; ORICELLO, It. A violet-red, purple, or blue colouring matter or dye-stuff, obtained from several species of lichens, but of the finest quality from *Roccella tinctoria* (DC.), and next from *R. fuciformis* (DC.).

The archil of commerce is met with as a liquid paste, or as a thin liquid dye or stain of more or less intensity. The ordinary archil or orchil of the shops (ORCHIL-LIQUOR) is under the last form; and is known as either BLUE or RED ARCHIL—distinctions which arise as follows:

Prep. 1. BLUE ARCHIL: The bruised or coarsely ground lichen is steeped for some time in a mixture of stale urine, or bone-spirit, and lime or milk of lime, or in any similar ammoniacal solution, contained in covered wooden vessels in the cold; the process being repeated until all the colour is extracted.

2. RED OR CRIMSON ARCHIL: The materials are the same as for the last variety, but rather less milk of lime is used, and the 'steep' is generally made in earthen jars placed in a room heated by steam, technically called a stove. The two kinds merely differ in the degree of their red or violet tint—the addition of a small quantity of lime or alkali to the one, or of an acid to the other, immediately bringing them both to the same shade of colour.

Prop. Archil has a disagreeable putrid ammoniacal odour. Its colouring matter is soluble in water, alcohol, urine, ammoniacal and alkaline lyes, and weak acid liquors; alkalies turn it blue, acids red; alum gives with it a brownish-red precipitate, and solution of tin a red one; the alcoholic solution gradually loses its colour when excluded from the air. Its colouring matter consists chiefly of orcein.

Pur. Archil is frequently adulterated with extract of logwood, or of Lima or Sapan wood. It may be tested as follows:—1. A solution of 50 or 60 drops of pure archil in about 3 fl. oz. of water slightly acidulated with acetic acid almost entirely loses its colour, or presents only a yellowish tinge, when heated to ebullition in a flask along with 50 drops of a fresh solution of protochloride of tin made with 1 part of the salt to 2 parts of water. 2. A drop of fluid extract of logwood, treated in the same way, gives a distinct violet tint, which resists several hours' boiling; but when only 3% or 4% of logwood is present the boiled liquid has a permanent grey tint. 3. If the boiled liquid retains its red hue extract of Sapan-wood is present. 4. The boiled liquor, when the archil is pure, re-acquires its colour by exposure to the air and the addition of an alkali, particularly ammonia; whilst the colour produced by logwood is destroyed only by an alkaline solution of tin, and is restored by acids.

Uses, &c. It is employed to tinge the spirit used to fill the tubes of thermometers, and to stain paper, wood, &c. The aqueous solution stains MARBLE, in the cold, of a beautiful violet

colour, of considerable permanence when not exposed to a vivid light. "Marble thus tinged preserves its colour unchanged at the end of two years" (*Dufay*). Its principal use is, however, in dyeing. By proper management it may be made to produce every shade of pink and crimson to blue and purple. Unfortunately, although the hues it imparts to silk and wool possess an exquisite bloom or lustre, they are far from permanent, and, unless well managed, soon decay. It is hence generally employed in combination with other dye-stuffs, or as a finishing bath to impart a bloom to silk or woollens already dyed of permanent colours. In using it as a dye it is added to hot water in the required quantity, and the bath being raised to nearly the boiling-point, the materials are put in and passed through it, until the desired shade is produced. A mordant of alum and tartar is sometimes used, but does not add to the permanence of the colour. Solution of tin added to the bath increases the durability, but turns the colour more on the scarlet (*Hellot*). Milk of lime or salt of tartar is added to darken it; acids or solution of tin to redden it. A beautiful crimson-red is obtained by first passing the stuff through a mordant of tin and tartar, and then through a bath of archil mixed with a very little solution of tin. By the proper management of this dye, lilacs, violets, mallows, rosemary flower, soupes au vin, agates, and many other shades may be produced on silk or cloth, either alone or in conjunction with other dyes to modify it. ½ *lb.* of solid archil, or its equivalent in a liquid form, will dye 1 to 2 *lbs.* of cloth. HERB-ARCHIL, it is asserted, will bear boiling, and gives a more durable tint than the other lichens, especially with solution of tin (*Hellot*). Recently Mr Lightfoot has patented a process for dyeing with archil with the aid of oil, after the manner followed for producing Turkey-red on cottons.

Archil, Facti''tious:—1. From a mixture of onions (in a state of incipient putrefaction) with about 1-10th to 1-12th their weight of carbonate of potash and some ammonia, fermented together; and adding, after some days, 1-7th to 1-8th of the weight of the potash used in a salt of lead. The details of the process essential to success are, however, now unknown, the secret having died with a relative of the writer of this article.

2. Extract of logwood dissolved in juice of elderberries and putrid urine, with the addition of a little pearlash for the BLUE, and a very little oxalic acid or oil of vitriol for the red variety. Used to stain wood.

Arch'il, Herb. *Roccella tinctoria.* See ARCHIL (*above*), LICHENS, and MOSSES.

ARCHITECTURAL SUBJECTS, PHOTOGRAPHY OF. See PHOTOGRAPHY and LENSES.

ARCUDUCT. The 'Arcuduct,' or the bow-guide, is a small instrument, devised and patented (1889). It is an appliance that is easily attached to the finger-board of violins and violoncellos, and has for its object the guiding of the bow in the proper position. The appliance itself is made of wire bent into the necessary form, and filled at the end with a small clamp, actuated by a screw with a milled head. By this clamp it is attached to the upper right-hand corner of the finger-board of the violin. Starting from the clamp, the wire is bent in such a manner as to form two arches about ⅝ inch apart in the small size, which cross the strings just midway between the top of the finger-board and the bridge. In playing the violin, the bow should cross the strings in a direction at right angles to the strings themselves, and midway between the bridge and end of the finger-board. The inventor claims that the young violinist, when compelled to keep the bow between the two arches of wire is obliged to draw it across the strings just in the right place, and thus is led to acquire a habit of bowing which is never forgotten.

ARDENT FEVER. When at the hot season of the year a child is attacked with a sudden and violent fever, the temperature running up to 105°, 106°, 107°, or even higher, such a fever is an ardent fever, for the time being at all events. It may be that it will subside in due course as a simple fever does, or it may even be that it will eventually prove to be a violent intermittent or remittent fever. Ardent fever, so called, is not uncommon in children in India, and may result from various causes; it is a serious disorder, and requires prompt and efficient treatment. Birch recommends the cold bath followed by quinine, in doses suited to the age of the child.

During the progress of recovery the points demanding scrupulous attention are—(1) The most absolute tranquillity; (2) the free opening of the bowels by means of an enema in the first instance, and then the administration of a purgative; (3) surrounding the patient with a cool atmosphere, which should be kept in active motion with the punkah; (4) the most simple diet; and if there be sleeplessness and unusual crossness after recovery from immediate danger, the administration of a dose of chloral and, after a few days, bromide of potassium.

ARE (ăr; āre—Eng.) [Fr.] See MEASURES.

ARE'CA. [L.] In *botany*, a genus of East Indian trees, of the Nat. Ord. PALMÆ (DC.).

Areca Cate'chu. [L.; Linn.] *Syn.* ARE'CA, A. IN'DICA, A. FAUFEL, BE'TEL-NUT TREE. *Hab.* East Indies. Fruit (BETEL-NUT), astringent and narcotic: it contains two alkaloids, *Arecoline* and *Arecaine;* husk of fruit (PENANG or PINANG), sialogogue and stomachic; both are used as masticatories; wood and nut yield an inferior or bastard sort of catechu; charcoal of the nut highly esteemed as tooth-powder; also given in tape-worm in doses of ¼ *oz.* and ½ *oz.*; said to be more efficacious in coarse than in fine powder.—*Doses for Animals.* HORSE, 4 to 6 drachms; CATTLE, 4 to 8 drachms; DOG, 30 grains to 2 drachms.

Areca Globulif'era. [L.] Properties similar to the last.

Areca Olera'cea. [L.; Willd.] Cabbage-palm.

ARENA'CEOUS (ăr-e-). *Syn.* ARENA'CEUS, L.; ARÉNACÉ, SABLONNEUX, Fr.; SANDIG, SANDARTIG, Ger. In *agriculture, mineralogy,* &c., sandy; resembling sand; friable.

ARENA''RIOUS (-nare'-). *Syn.* ARENA''RIUS, L.; ARÉNAIRE, Fr. Sandy, arenaceous. In *agriculture* and *botany,* applied to soils (ARENARIOUS SOILS) in which sand is the prevailing and characteristic ingredient; also to plants that grow in sandy or arid soils.

ARENA'TION. *Syn.* SABURRA'TION; ARENA'TIO, L.; ARÉNATION, Fr.; SANDBAD, Ger. In *medicine*, sandbathing; a practice formerly prevalent, in dropsy, of applying hot sand, either by immersion or otherwise, to the feet, legs, or even the whole body.

ARENOSE' (ăr-e-nōse'). *Syn.* AR'ENOUS*; ARENO'SUS, L.; ARÉNEUX, Fr. Sandy; arenaceous (which *see*).

AREOM'ETER. *Syn.* AREOM'ETRUM, L.; ARÉOMÈTRE, Fr. See HYDROMETER.

AREOM'ETRY. *Syn.* AREOME'TRIA, L.; ARÉOMÉTRIE, Fr. The art or operation of ascertaining the specific gravity of liquids, and hence, in many cases, their strength or commercial value also; hydrometry. See AREOMETER (*above*), HYDROMETRY, SPECIFIC GRAVITY, &c.

ARGEMONE MEXICANA (Nat. Order PAPAVERACEÆ). A tropical American plant, now a common weed growing in almost every part of India. A fixed oil is obtained from the seeds by expression, which has long been employed as an aperient in the West Indies. In half-drachm doses it is said to act as a gentle aperient, and at the same time it allays, apparently by its sedative qualities, the pain in colic. The smallness of the dose and the mildness of its operation commend it to the notice of the medical practitioner. Its efficiency is impaired by keeping, the freshly prepared oil proving more active and uniform in its action than that which has been long on hand. It is reported to exercise a well-marked and soothing influence when applied to herpetic eruptions and other forms of skin disease. By the natives of India the expressed, yellow, glutinous juice of the plant is held in high repute as a local application to indolent and foul ulcers.

ARGENT'INE (-ĭn). *Syn.* ARGENTI'NUS, L.; ARGENTIN, Fr.; SILBERFARBEN, &c., Ger. Silver-like; pertaining to, resembling, or sounding like silver; argental.

Ar'gentine (-tĭn). [Eng., Fr.] German silver.* In *mineralogy*, nacreous carbonate of lime, from its whiteness and silvery lustre.

ARGENTOMETER. An instrument for determining the strength of the silver solutions used in photography for sensitising paper, &c. It is practically an hydrometer graduated for solutions of silver nitrate, and, though useful for pure solutions, is very untrustworthy, when, as is almost always the case, the solution contains other salts; any of the rougher methods of analysis will give far more reliable results.

ARGENT'UM. [L.] Silver. In *old chemistry* and *pharmacy*, ARGENTUM, FUGITI''VUM†, A. MO'BILE† (-ĭl-e), was quicksilver; A. MOR'TUUM†, dead silver, grain-s.; A. MUSI'VUM†, mosaic s., silver-bronze; A. NITRA'TUM†, lunar caustic; A. VI'VUM†, quicksilver; A. ZOÖTIN'ICUM†, cyanide of silver; &c.

AR'GIL† (-jĭl-). *Syn.* ARGIL'LA, L.; ARGILE, Fr. Clay or potter's earth.

ARGILLA'CEOUS (-jĭl-). *Syn.* ARGILLA'CEUS, L.; ARGILLEUX, Fr.; THONIG, THONARTIG, Ger. Clayey; pertaining to, containing, or of the nature of clay or argil. In *agriculture*, an epithet of soils (ARGILLACEOUS SOILS) of which clay is the principal or characteristic ingredient.

Argil'lo-arena'ceous (-jĭl-). In *agr.*, consisting chiefly of clay and sand.

Argillo-calca''reous. In *agr.*, consisting chiefly of clay and chalk.

AR'GOL. *Syn.* ARGAL; TARTARUS CRUDUS, L.; TARTRE BRUT, Fr.; WEINSTEIN, Ger. Crude bitartarate of potassium, as deposited by wine. That from red wine is RED ARGOL; that from white wine, WHITE ARGOL. See TARTAR.

ARI'CINA. $C_{23}H_{26}N_2O_4$. An alkaloid discovered by Pelletier and Corriol, in white cinchona bark from Arica, also in bark of cinchona cupræa. It is extracted from the bark by the same process as quinine, viz. by boiling the bark with acidulated water, treating the liquor with lime, and digesting the lime-precipitate in alcohol. The solution filtered at the boiling heat yields a very dark-coloured liquid, which, after a time, deposits the greater part of the aricine in crystals. An additional quantity may be obtained from the mother-liquor by expelling the alcohol by distillation, treating the residue with a slight excess of hydrochloric acid, separating the greater part of the colouring matter by means of a saturated solution of common salt, then throwing down the aricine by ammonia, dissolving the precipitate in alcohol, decolourising with animal charcoal and crystallising.

ARISTOLOCHIA SERPENTARIA (L.) VIRGINIAN SNAKE-ROOT. A native of moist fertile woods in the United States of America. At one time it had a reputation for the cure of the bites of venomous serpents, as its common and specific names imply. It is now used as a stimulant tonic. Guaco, the root of one or two species of *Aristolochia*, possesses considerable repute as a cure for the bite of serpents. *Aristolochia Goldieana*, Hook, f., from Western Tropical Africa, has a remarkably large flower.

ARISTOTYPE PAPER. See PHOTOGRAPHY.

ARM'ATURE (-ă-tūre). *Syn.* ARMATU''RA, L. In *magnetism*, a piece of soft iron used to connect the poles of a horseshoe magnet, for the purpose of preventing loss of power.

ARNATT'O, Arnott'o. See ANNOTTA.

AR'NICA. [L., Fr., Eng.] *Syn.* ARNIQUE, Fr.; ARNIKA, WOLVERLEI, Ger. In *botany*, a genus of plants of the Nat. Ord. COMPOSITÆ (DC.). In the Ph. U. S., *Arnica montana* (see *below*).

Arnica Monta'na. [L.; Linn.] *Syn.* ARNICA, MOUN'TAIN A., M. TOBAC'CO, GERMAN LEOP'ARD'S BANE; PANACE'A LAPSO''RUM*, L.; ARNIQUE, A. DES MONTAGNES, TABAC DES SAVOYARDS ET DES VOSGES, Fr.; ARNIKA, FALKRAUT, &c., Ger. *Hab.* A perennial herb, native of moist meadows throughout Northern and Central Europe, and found on mountains in Switzerland, North Italy, and the Pyrenees. Arnica root of commerce consists of the dried rhizome and attached rootlets. These and the flowers have a slight aromatic odour, and an acrid bitter taste. It is now cultivated in our gardens. Flowers (ARNICA, Ph. U. S., Castr. Ruth., and Bor.) and leaves, diaphoretic, diuretic, stimulant, and narcotic; in large doses emetic and purgative; root discutient; whole herb diaphoretic, stimulant, and nervine. Arnica, however, is chiefly used in the form of a tincture for

outward application in sprains, bruises, chilblains, &c.

Prop., *&c.* Arnica acts as an energetic stimulant on the cerebro-spinal system, and as an irritant on the stomach and bowels. It is much employed on the Continent, and is given in a great variety of diseases—amaurosis, chlorosis, convulsions, diarrhœa, dysentery, gout, paralysis, rheumatism, &c. It is much used in Germany, instead of bark, in intermittents, putrid fevers, and gangrene. In France it is commonly employed as an excito-tonic in paralysis. It has been greatly extolled as a restorative, and in bruises and injuries from falls. The Savoyards and inhabitants of the Vosges both smoke and 'snuff' the leaves. In England it is little used except by homœopaths. It is said that no animal but the goat will eat this plant (*Thomson*). Its noxious properties chiefly depend on the presence of cytisine.—*Dose.* Flowers, 5 to 10 gr., in powder, with syrup or honey; root, 10 to 20 gr. It is most conveniently administered under the form of infusion or tincture. Severe abdominal pains and vertigo, and even tetanus and death, have followed excessive doses.

Obs. According to Dupuytren, the emetic action of infusion of arnica depends on minute particles of the down of the plant which remain suspended in it, and which may be removed by filtration. See INFUSIONS, TINCTURES, &c.

AR'NICIN (sĭn). This name has been applied to two substances—the one discovered by Pfaff; the other by Bastick:

Arnicin (of *Pfaff*). The resinous matter extracted by alcohol from the roots and flowers of mountain arnica, and in which their acridity appears to reside.

Arnicin (of *Bastick*). *Syn.* ARNICI'NA, ARNICI''A (nĭsh'-y'ă), L. *Prep.* 1. (*Bastick.*) From the flowers, by a similar process to that by which he obtains lobelina. 2. From the flowers (or root), as directed under ARICINA.

Prop., *&c.* Bitter; acrid; crystallisable; scarcely soluble in water; soluble in alcohol and ether; forms salts with the acids, the hydrochlorate and one or two others being crystallisable. Its physiological properties and dose have not as yet been accurately determined.

AROMA. [L.] *Syn.* AROME, Fr.; AROM, GERUCHSTOFF, Ger. The characteristic odour of substances, particularly the peculiar quality of plants, and of substances derived from them, which constitutes their fragrance.

AROMA'TA. [L.] See AROMATIC.

AROMAT'IC. *Syn.* AROMAT'ICUS, L.; AROMATIQUE, Fr.; GEWÜRZHAFT, Ger. Fragrant, odoriferous; spicy; applied chiefly to plants and their products (AROMATICS, A. PLANTS; AROMAT'A, AROMAT'ICA, L.; AROMATIQUES, ÉPICES, Fr.; GEWÜRZ, Ger.) characterised by their spicy odour or aroma, and warm pungent flavour, and of which allspice, cinnamon, cloves, lavender, pepper, rosemary, sage, &c., are well-known examples. They are all stimulant, carminative, and antiseptic; and from remote antiquity have been regarded as prophylactic and disinfectant.

AROMATIC SULPHUR-SOAP (*Ed. Heger*). For cleansing the teeth and mouth. A hard sulphur-coloured soap externally; on cutting, greyish-brown. Composed of soap with 10% of hyposulphite of soda, perfumed with a scent resembling oil of balm (*Hager*).

AROMATIQUE (*Albin Müller, Brünn*). Spirit (90%), 50 grms.; sugar, 45 grms.; extractive matter, 4 grms. (composed of cinnamon, cloves, galangal, zedoary, angelica, anise); water, 81 grms. Sold in winebottle-shaped bottles, and recommended for all derangements of the digestive organs (*Hager*).

ARQUEBUSADE' (ar-ke-bōō-zade'). [Fr.] Primarily, the shot of an arquebuse; but afterwards applied to an aromatic spirit (EAU D'ARQUEBUSADE, Fr.), originally employed as an application to gunshot (arquebuse) wounds.

ARRACACHA (*Arracacia esculenta*, DC.). An umbelliferous plant, with edible tubers, from which a sort of flour is prepared; extensively cultivated in the Andes, and naturalised in Jamaica.

AR'RACK (*Syn.* RACK) (arrack'—*Brande*). [Ind.] *Syn.* ARAC, ARACK, RACK‡§; PALM-SPIRIT; AR'AC'CA, SPIR'ITUS PAL'MÆ, S. SUC'CI P., S. ORY'ZÆ*, L.; ARACK, Fr.; ARAK, Ger. A spirituous liquor imported from the East Indies. The finer qualities are distilled from the fermented juice (toddy, palm wine) of the cocoa-nut tree, palmyra tree, and other palms; and the other kinds, from the infusion of unhusked rice (rice beer), fermented with cocoa-nut or palm juice, either with or without the addition of coarse sugar or jaggery.

Prop., *&c.* It is colourless or nearly so, but like other spirit, when long kept in wood, gradually acquires a slight tinge, similar to that of old Hollands. The best kinds, when of sufficient age, are pleasant flavoured, and are probably as wholesome as the other spirits of commerce; but common arrack has a strong and somewhat nauseous flavour and odour, depending on the presence of volatile oil derived from the rice, and corresponding to that of corn spirit. The inferior qualities are hence more heating and apt to disagree with the stomach than the other commercial spirits. In this country it is chiefly used to make punch. When sliced pine-apples are put into good arrack, and the spirit kept for some time, it mellows down and acquires a most delicious flavour, and is thought by many to be then unrivalled for making 'nectarial punch' or 'rack punch.'

Obs. Batavian arrack is most esteemed; then that of Madras; and next that of China. Others are regarded as inferior. The common par'iah arrack is generally narcotic, very intoxicating, and unwholesome; being commonly prepared from coarse jaggery, spoilt toddy, refuse rice, &c., and rendered more intoxicating by the addition of hemp leaves, poppy-heads, juice of stramonium, and other deleterious substances.

Arrack, Facti''tious. *Syn.* MOCK AR'RACK, BRIT'ISH A.; VAUXHALL' NEC'TAR; &c. *Prep.* Good old Jamaica rum (uncoloured), rectified spirit (54 to 56 o. p.; clean flavoured), and water, of each 1 quart; flowers of benzoin, 1 dr.; sliced pine-apple, ¼ oz. (or essence of pine-apple, ½ teaspoonful); digest, with occasional agitation, for a fortnight; then add of skimmed milk, 1 wineglassful; agitate well for fifteen minutes, and in a few days decant the clear portion.

The crude Indian arrack, when subjected to distillation until it has a sp. gr. ·920, is employed in India, as proof spirit, in the preparation of official tinctures, and for other pharmaceutical purposes. A very useful stimulating application, known in India as toddy poultice, and intended as a substitute for yeast poultice, is prepared by adding freshly drawn toddy to rice flour, till it has the consistence of a soft poultice, and subjecting this to heat over a gentle fire, stirring constantly till fermentation commences.

The light brown cotton-like substance from the outside of the base of the fronds belonging to the Palmyra palm is employed by the Cingalese doctors as a styptic for stopping the hæmorrhage of superficial wounds.

ARRANGEMENT, DEEDS OF. All deeds of arrangement made since the passing of the Deeds of Arrangement Act, 1887, are governed by that Act, which applies to any of the following instruments, whether under seal or not, made by, for, or in respect of, the affairs of a debtor, for the benefit of his creditors generally (otherwise than in pursuance of the law for the time being in force relating to bankruptcy), that is to say:

(*a*) An assignment of property.

(*b*) A deed of, or agreement for, a composition:

And in cases where creditors of a debtor obtain any control over his property or business:

(*c*) A deed of inspectorship entered into for the purpose of carrying on, or winding up, a business.

(*d*) A letter of licence authorising the debtor or any other person to manage, carry on, realise, or dispose of, a business with a view to the payment of debts.

(*e*) Any agreement or instrument entered into for the purpose of carrying on, or winding up, the debtor's business, or authorising the debtor or any other person to manage, carry on, realise, or dispose of, the debtor's business with a view to the payment of his debts.

If the instrument be executed in England, it must be registered within seven clear days of its execution; if executed *out* of England or Ireland, it must be registered within *seven clear days* of the time at which it would, in the ordinary course of post, arrive in England or Ireland respectively if posted *within a week* of its execution.

A true copy of the deed and the schedule or inventory must be filed with the Registrar in like manner as bills of sale for securing money, together with an affidavit verifying the time of execution, and showing the residence and occupation of the debtor and his place of business; also an affidavit by the debtor showing the estimated amount of his property and liabilities included under the deed, the total amount of the composition (if any) payable thereunder, and the names and addresses of his creditors. The original deed must be duly stamped, and in addition a stamp denoting a duty of one shilling per £100, or fraction of £100, of the sworn value of the property passing under the deed, or (where no property passes) of the amount of composition payable under the deed.

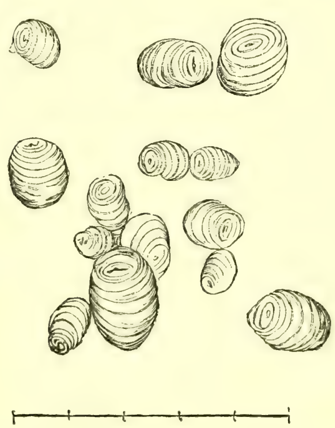
The Registrar of Bills of Sale in England and Ireland respectively is the Registrar for the purposes of the Deeds of Arrangement Act, 1887.

AR'ROW-ROOT. The common name of *Maran'ta arundina'cea,* Linn.; *Indica*—Tuss.; a plant of the Nat. Ord. MARANTACEÆ, Lindl.; CANNACEÆ, Endl. It was originally brought from the island of Dominica to Barbadoes, by Col. James Walker. It has since been extensively cultivated in the West Indies.

Tubers yield true ARROW-ROOT; when fresh and good they contain about 26% of starch, of which 23% may be obtained as arrow-root, and the rest by boiling.

Arrow-root. *Syn.* MARAN'TA, AM'YLUM MARAN'TÆ, FÆC'ULA M., L.; RACINE FLÉCHIÈRE, PIVOT, Fr.; PFEILWURZ, P.-SATZMEHL, Ger. The starch or fecula obtained from the rhizoma or tubers of *Maran'ta arundina'cea,* Linn. (see *above*), and which forms the true 'arrow-root' of commerce.

Prep. The fecula is extracted from the tubers when they are about 10 or 12 months old, by a process similar to that by which the farina is obtained from potatoes. In Bermuda the tubers, after being washed, are deprived of their paper-like scales and every discoloured and defective part by hand; they are then again washed and drained, and next subjected to the action of a wheel-rasp, the starch being washed from the comminuted tubers with rain-water; the milky liquid is passed through a hair-sieve or a coarse cloth, and allowed to deposit its fecula. This is then allowed to drain, after which it is again carefully washed with clean water, again drained, and, after being thoroughly dried in the air or sun, is at once packed for market (*Cogswell*).



West Indian Arrow-root (*Maranta arundinacea*). Scale 1-1000th of an inch.

In St Vincent (on the Hopewell Estate) a cylindrical crushing-mill, tinned copper washing machines, and German-silver palettes and shovels are employed; whilst the drying is effected in extensive sheds, under white gauze, to exclude insects. In Jamaica the washed tubers are generally pulped in deep wooden mortars; machinery being seldom employed in any part of the process.

Prop., &c. A light, dull, dead-white, tasteless, inodorous powder or small pulverulent masses, feeling firm to the fingers, and crackling when pressed or rubbed; viewed by a pocket lens it appears to consist of glistening particles, which are shown by a microscope to be convex, irregular, ovoid or truncated granules, most of them, according to Mr Jackson, being ·0010 of an inch in length, and ·0008 of an inch in breadth; mixed with others varying from about double to only half that size. In its action with boiling water and its general properties it resembles the other starches; than which, however, it is freer from any peculiar taste and flavour; and thus agrees better with the delicate stomachs of invalids and infants than the ordinary farinas.

Comp. Similar to that of the other starches.

Pur. A large portion of the arrow-root of the shops consists either wholly or in part of the fecula or farina of potatoes or of inferior starches such as *cacuma*, or East Indian arrow-root, *jatropha*, or Brazilian arrow-root, *canna*, or *tous les mois;* or is more or less mixed with sago-meal or rice-meal; such materials can be readily detected by the microscope. Potato-starch is known in commerce as 'FARINA' or 'BRITISH ARROW-ROOT,' or simply 'arrow-root;' whereas genuine arrow-root is always described as 'Bermuda,' 'St Vincent,' 'St Kitts,' or, at least, as 'West Indian arrow-root.' The substitution of the inferior farinas for genuine arrow-root is not only fraudulent on account of their inferior value, but is reprehensible from a hygienic point of view; as some of them are offensive to a delicate stomach, and exert of themselves, and still more when carelessly manufactured, a laxative action on the bowels; whereas the effect of true arrow-root is that of a slight and soothing tonic.

Uses, &c. As an agreeable, non-irritable article of diet for invalids and children, in the form of cakes, biscuits or puddings, or boiled with milk or water and flavoured with sugar, spices, lemon-juice, or wine, at pleasure. For young children a little caraway or cinnamon water is to be preferred. It is especially useful in irritation or debility of the stomach, bowels, or urinary organs, and in all cases in which a demulcent or emollient is indicated. It must not, however, be employed to the entire exclusion of other food, as, being destitute of the nitrogenous elements of nutrition, it is incapable alone of supporting life. Arrow-root jelly is prepared by first rubbing the powder up with a very small quantity of cold water, and then gradually adding the remainder boiling, stirring well all the time. Beef-tea, veal broth, or milk may be used instead of water. Some persons boil it for a few minutes. This jelly, flavoured with a little genuine port wine and nutmeg, is almost a specific in cases of simple diarrhœa arising from habit or debility.

Obs. Arrow-root is imported in tins, barrels, and boxes from all the West India Islands; and from Calcutta and Sierra Leone. The best quality was, until recently, solely obtained from Bermuda; but of late equally fine samples have been produced on the Hopewell Estate, St Vincent, and, according to Dr Ure, with the advantage of being prepared with the purest spring water in profusion instead of rain water.

In *commerce*, the word arrow-root is now often loosely used as a generic term to indicate any white, tasteless, and edible starch or fecula.

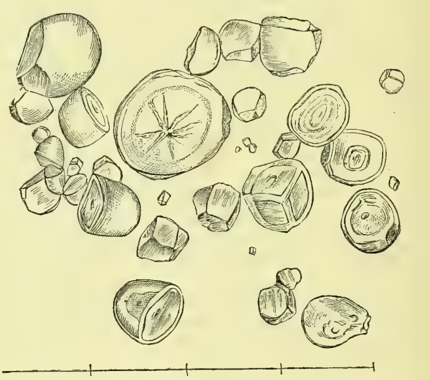
Arrow-root, Brazil'ian. Cassava-starch or tapioca-meal.

Arrow-root, East In'dian. Curcuma starch; from the tubers of the *Curcuma angustifolia* or narrow-leaved turmeric. The *Maranta arundinacea* is now also extensively cultivated in India under the name of *Maranta indica*, and the fecula therefrom extensively exported, which might, with equal propriety, be called East Indian arrow-root; but this is not the case in commerce, the whole passing as W. I. arrow-root, irrespective of the place of its production.

Arrow-root, Eng'lish. Potato-starch.

Arrow-root, Port'land. From the underground tubers of *Arum maculatum*, Linn., or wake-robin.

Arrow-root, Tahi'ti. Tacca starch or Otaheite salep; from the tubers of *Tacca oceanica.*



Rio, or Manihot Arrow-root. Scale 1-1000th of an inch.

Arrow-root is also prepared from Burrawang Nut (*Macrozamia spiralis*, Miq.), a native of New South Wales.

ARSENIC. Symbol As. Atomic weight, 74·9; sp. gr. 5·71 to 5·73; vapour density, 149·8. *Syn.* ARSENIUM; ARSEN'ICUM, ARSE'NIUM, L.; ARSENIK, A. METALL, Ger.; ARSENICO, Sp., It. The word 'arsenic' ought, strictly speaking, to be applied to the element alone, but from long habit it is frequently also used for the trioxide (*white* arsenic), As_2O_3. In this article we shall apply it only to the element.

Hist. Geber (in the 8th century) was probably aware that a metal-like substance was contained in white arsenic, but Albertus Magnus (in the 13th century) was the first to state this distinctly. The property which arsenic possessed of rendering copper white was well known to the alchemists, and contributed to the belief in the possibility of transmuting the latter metal into silver. The later alchemists regarded arsenic as a bastard or semi-metal; Brandt, in 1773, first proved that white arsenic (As_2O_3) was produced by its combustion.

Sources, &c. Arsenic occurs native in various localities; among others, at Andreasberg in the Harz. It is also found as white arsenic (As_2O_3), but its chief ores are arsenical iron, $FeAs_2$ and Fe_4As_3; arsenical pyrites or mispickel, $FeAsFeS_2$;

arsenical nickel, NiAs; realgar, As_2S_2, and orpiment, As_2S_3. Small quantities of arsenic also occur in many other minerals, iron pyrites almost always containing it; traces of it are likewise present in nearly all mineral waters.

Prep. (*a*) On the large scale. The mispickel (or other ore employed) is pounded, some pieces of iron added to it, and the mixture moderately heated by a fire, either in earthenware tubes, with sheet-iron ones so attached to them that half of the latter are inside the former; or, instead of tubes, earthenware retorts may be employed. The iron present retains the sulphur, and the arsenic sublimes into the iron tube, from which it is obtained by unrolling the latter. The reaction is represented by the following equation:

$$FeAsFeS_2 = 2FeS + As.$$

The commercial product thus prepared is a brittle crystalline mass, with strong metallic lustre; in order to purify it, it is mixed with a small quantity of powdered charcoal and re-sublimed.

(*b*) On the small scale it is prepared by subliming at a low red heat a mixture of 1 part of white arsenic with 2 to 3 parts of black flux in a Hessian crucible, over which a deep empty crucible or earthenware tube is luted, to receive the metal; the receiver must be kept as cool as possible. Charcoal or even oil may be substituted for black flux, and a retort of hard glass may be used instead of a crucible. Another method is to place 2 dr. of the white arsenic of commerce in the sealed end of a tube of hard Bohemian glass, then fill in about 8 in. of dry and coarsely powdered charcoal, and gradually raise the latter to a red heat. After this the trioxide is cautiously sublimed over the charcoal, which reduces it, the metallic arsenic collecting at the cool end of the tube. A gas or charcoal furnace similar to those used for organic analysis should be employed, and the process conducted underneath a flue with a good draught, to carry off any fumes that may escape. The open end of the tube should be *loosely* closed with a cork with a small slit in it.

Props. Arsenic is in many of its physical properties metallic, but in its chemical relations it is decidedly non-metallic or negative. It possesses a steel-grey or bluish-white colour, a highly metallic lustre, and a crystalline texture (crystalline form, rhombohedral), and it is so brittle as to be easily powdered in a mortar. Its sp. gr. is 5·71 to 5·73 (but two amorphous modifications of it can be prepared whose sp. gr. is only 4·71). It readily sublimes unaltered in the absence of air, without fusion, at 180°—182° C. (356°—360° F.), and more slowly at lower temperatures, but it fuses under increased pressure; when the air has access, it is oxidised to the trioxide, As_2O_3. At a higher temperature, in open vessels, it burns with a pale blue flame. Its vapour has a characteristic garlic odour. It is slowly oxidised and dissolved by boiling water, but may be preserved unchanged in pure cold water; it rapidly tarnishes in moist air, a black film forming on its surface. Arsenic is readily oxidised by nitric acid, and also by concentrated sulphuric acid with evolution of sulphur dioxide. It combines with most of the metals and with various non-metals. In general chemical properties arsenic is most nearly allied to phosphorus on the one hand and to antimony on the other.

Uses, &c. With copper it forms a white alloy (PACKFONG); and it is added to some other alloys to increase their whiteness, hardness, and fusibility. A small quantity of arsenic added to shot-metal appears to assist in securing a perfectly spherical form, and at the same time increases the hardness of the shot. In *medicine*, it is only used in combination. In the metallic state it is inert; but, from its great affinity for oxygen, it rapidly becomes oxidised and poisonous; and hence acts as a powerful poison when swallowed, or when rubbed on the skin. Its fumes are also highly poisonous. See ARSENIOUS ACID (and *below*).

For *detection* and *estimation*, see *below*.

Arsenic, Oxides and Oxy-acids of. Two oxides of arsenic are known, viz. the trioxide and the pentoxide.

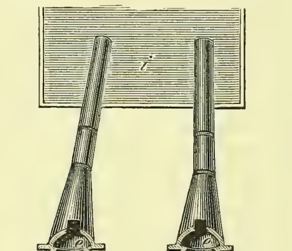
Arsenious Oxide, or **Arsenious Anhydride,** As_4O_6. *Syn.* AR'SENIOUS ACID, AR'SENIC, WHITE A.; ACIDE ARSÉNIEUX, ARSENIC BLANC, OXYDE D'A., Fr.; ARSENIGSÄURE, Ger.; ARSENICO BIANCO, It.; A. BLANCO, Sp. The arsenic, or white arsenic, of the shops. The formula As_4O_6 is the true molecular formula for this oxide, but it will often be found convenient—*e. g.* in equations—to refer to it as As_2O_3.

Sources and Prep. Arsenic trioxide (commonly called arsenic) is prepared in many metallurgical processes by the roasting of arsenical ores. The white arsenic of commerce is largely imported from Germany, where it is obtained (*a*) at Freiberg in Saxony, as a by-product, in the roasting of cobalt ores for the preparation of smalt; (*b*) at Altenburg from arsenical pyrites or mispickel; (*c*) at Reichenstein from native arsenide of iron; and (*d*) in the Harz. The crude sublimate obtained in the Freiberg mines contains about 75% of the trioxide. Large quantities are also manufactured in Devon and Cornwall, from the roasting of grey copper ore and tin ore containing arsenical pyrites. The British Arsenic Works in the latter county are, perhaps, the finest in the world. Formerly the usual plan was to roast the powdered ore in muffled furnaces, but now open roasters are supplanting the latter. The arsenic of the ore is converted into the trioxide, which escapes as vapour (smelting-house smoke), and, passing into the long condensing chambers (termed poison chambers), is deposited in the pulverulent state, forming the flowers of arsenic or rough white arsenic of the smelters (the *Giftmehl*, or poison-flour, of the Germans). "The hearth of such an open furnace is about 4 metres in length and about 2·8 metres in breadth, and in it 900 kilos of the ore can be roasted at once; four charges are made during the day, and the white powder which comes off collects in long underground passages of some 200 metres in length." . . . "Of late years Oxland's self-acting calciner has been much used for the manufacture of arsenic trioxide from the Cornish and Devonshire ores. This furnace consists of an iron tube, from 3 to 6 feet in diameter, and 30 feet long, set at an inclination of from half to one inch per foot, this varying according to the nature of the ore. The tube is heated by a fire placed at its lower end, whilst at its upper it is placed in connection with

the flues in which the white arsenic is deposited. The tube is made to revolve by suitable machinery at the rate of about one revolution in four minutes, and the crushed ore is admitted in a regular stream through a feed-pipe at the back end of the tube. Great economy of fuel is effected by this furnace; indeed, if properly worked with a good ore, the heat of combustion of the sulphur and arsenic is itself sufficient to carry on the process. One such cylinder turns out upwards of twenty-five tons of ore per diem, and the calcined product contains less than 0·5% of arsenic" (*Roscoe* and *Schorlemmer's* 'Chemistry,' vol. i).

Part of the arsenic trioxide comes into the market in the form of a white crystalline powder, and the rest as arsenic glass or amorphous arsenic, obtained from the former (when it is not white enough to be sold) by resublimation in suitable iron pots or other iron vessels. It then forms a semi-transparent vitreous cake, which gradually becomes opaque and of snowy whiteness by exposure to the air, and at length acquires a more or less pulverulent appearance on the surface.

In Silesia the crude arsenious anhydride obtained from arsenical pyrites is refined by sublimation as follows:—For this purpose the cast-

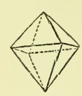


iron vessels (*a*) are employed. Upon these are placed iron rings or collars (*b*, *c*, *d*) and a hood (*e*), communicating by means of tubes with a series of chambers, of which the first only is shown in *i*. The flanges of the cast-iron collars and all other joints having been thoroughly luted, the fire is lighted and the heat so increased as to cause the semi-fusion of the arsenious anhydride, which, after cooling, exhibits a peculiarly porcelain-like appearance, being at first as transparent as glass.

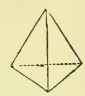
To obtain the trioxide pure, two sublimations are necessary. Further, care must be taken during the heating that none of it becomes reduced to metallic arsenic, which would not only darken the colour of the arsenic glass, but would also form a fusible alloy with the iron of the pots, and thus destroy them. If this occurs, the trioxide then falls into the furnace and escapes into the air, thus forming a continual source of danger to the workmen (*Roscoe* and *Schorlemmer*, loc. cit.).

Prop. Arsenic trioxide exists in three forms, amorphous, regular octahedra, and trimetric prisms. The first of these forms passes slowly into the second upon keeping; the third requires special conditions for its preparation. As obtained by careful sublimation, or by cooling a boiling aqueous solution, the trioxide is usually obtained in transparent regular octahedra (fig. 1), sometimes—though rarely—in tetrahedra (fig. 2).

1.



2.



When prepared on the large scale it forms large, glassy, colourless or yellowish-white, transparent or semi-transparent cakes or porcelain-like masses (vitreous arsenious anhydride, glacial a. a.), which soon become opaque on their external surface, and often friable and powdery. It volatilises at about 218° C., forming a colourless vapour, and it is odourless both in the solid state and in that of vapour (of course, when heated with carbonaceous matter it is reduced, and then the vapours smell of garlic. See Arsenic). It tastes faintly sweet, with a slight acidity and astringency, which is not perceived until some minutes after it has been swallowed. It is sparingly soluble in water (the opaque variety dissolves in 80 parts of water at 15° C. and in 7·72 parts at 100° C.; the transparent variety in 103 parts at 15° C., and in 9·3 parts at 100° C.), and slightly in alcohol; its aqueous solution reddens litmus. Hydrochloric acid dissolves it readily (forming the trichloride), and alkalies also (forming alkaline arsenites); it is therefore on the one hand a basic, and on the other an acidic oxide. Organic matter generally impedes its solution (but glycerine dissolves 10%). Arsenic trioxide acts both as a reducing and as an oxidising agent. It reduces nitric acid, for instance, being itself oxidised to arsenic acid, and it oxidises carbon, sulphur, &c., when heated with these bodies. The sp. gr. varies from 3·5 (lowest opaque variety) to 3·8 (highest transparent variety).

Arsenious Acid and the Arsenites. The true tribasic arsenious acid, the formula of which would be H_3AsO_3 (thus: $As_2O_3 + 3H_2O = 2H_3AsO_3$), has never been obtained pure. When a solution of the trioxide in water (which may be looked upon as a solution of the acid) is evaporated, the trioxide itself remains behind. Its salts, however, —the *arsenites*—are stable enough, and several series of them are known. The most important of them are the ortho-arsenites, *e.g.* silver ortho-arsenite, Ag_3AsO_3; and the meta-arsenites, *e.g.* potassium met-arsenite, $KAsO_2$. The arsenites of the alkali metals are soluble in water, those of the other metals insoluble in water but readily soluble in acids. The soluble arsenites act as very powerful poisons. See Uses of Arsenic in Medicine.

Two of them may be mentioned here.

Arsenite of Copper, or *Scheele's Green*, $Cu_2As_2O_5$, or $2CuO, As_2O_3$, is obtained by precipitating a salt of copper with arsenite of potassium, or with arsenious acid and a sufficient quantity of ammonia to neutralise the free acid present. It is a light green precipitate, and has been used as a colouring matter even for sweetmeats.

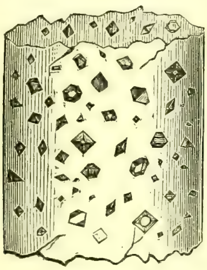
Aceto-arsenite of Copper, better known as *Schweinfurth Green* or *Imperial Green*,

$$3CuAs_2O_4, C_4H_6CuO_4,$$

which is much used as a pigment on account of its splendid green colour, is prepared on the large scale by boiling together arsenic trioxide, cupric acetate (verdigris), and water. See ARSENICAL PIGMENTS.

Tests for, and Detection and Estimation of Arsenic Trioxide and the Arsenites.

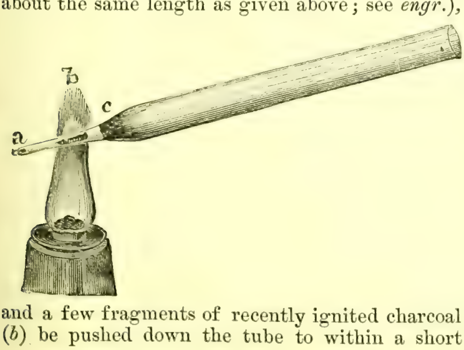
a. DRY TESTS. 1. When a minute quantity of arsenic trioxide is introduced into a small sublimation tube, closed at one end (about 8 cm. long and 7 mm. internal diameter), and the tube cautiously heated over a *Bunsen* gas-burner or spirit lamp, the trioxide sublimes, the sublimate collecting on the cooler part of the tube. This, when examined with a good pocket lens, is found to consist of sparkling octahedral crystals (see *engr.*). *Note.—It is essential, both for this and*



(Magnified.)

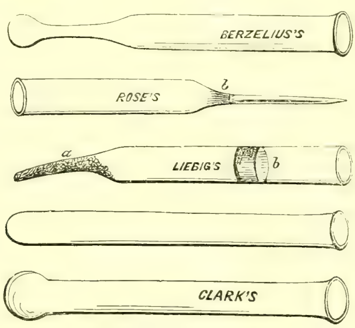
for all the other dry tests in which tubes are used, that the inside of the tube shall be quite clean, *i.e.* free from solid particles, before heat is applied; should any be seen adhering, they must be carefully cleaned out by means of a spiral of filter paper, leaving the sides of the tube perfectly bright. The common plan is to introduce the mixture through a small paper funnel or tube extemporised for the purpose.

2. If a little trioxide (*a*) be introduced into the pointed end of a drawn-out sublimation tube (of about the same length as given above; see *engr.*),



and a few fragments of recently ignited charcoal (*b*) be pushed down the tube to within a short distance of (*a*), and first the charcoal and then the trioxide heated to redness, a mirror of metallic arsenic will form at (*c*), owing to the reduction of the trioxide by the red-hot charcoal. *Note.*—If the charcoal be not properly ignited, it may give off a carbonaceous sublimate, which may possibly be mistaken for arsenic; a blank test, therefore, should first be made.

3. This last test may be performed somewhat differently by intimately mixing the powdered trioxide (or *any* solid arsenic compound) with about 3 or 4 times its weight of a suitable reducing mixture (*e.g.* a mixture of sodic bicarbonate and potassic cyanide; sodic bicarbonate and charcoal; potassic ferrocyanide dried at 100°; calcined bitartrate of potash; freshly ignited charcoal), bringing this into the bottom of a subliming tube, and filling in on the top of it some more of the reducing mixture alone. On strongly heating first the top portion and then the arsenical mixture, a sublimate of metallic arsenic will be deposited in the upper portion of the tube. The annexed engraving shows a number



a, The arsenical mixture.
b, Arsenical ring.

of different forms of tubes which are suitable for use, leaving out of account Rose's, which applies to test 2. The plain tube of the engraving is just as good as any other. *Note.*—The reducing mixtures should be carefully dried before use, as, when they are moist, steam is given off and the delicacy of the test is greatly impaired. The heat applied should be gentle at first, and merely sufficient to expel any adhering moisture from the mixture and the inner surface of the tube (any moisture can be conveniently sucked up by a spiral of filter paper), after which the upper portion of the mixture should be strongly heated, and then the bulb or bottom of the tube exposed to the full flame. After the operation is complete, the bulb or lower part of the tube is usually removed by a file, and the portion containing the deposit hermetically sealed, when it may be preserved, unaltered, for any length of time, ready to be produced as evidence if required, should a judicial case be involved in it.

This test is usually regarded as decisive, as we here actually obtain the arsenic in a solid form, recognisable by the most unequivocal characters.

The metallic ring is proved to be arsenical by the properties and tests which are partly detailed below and partly under 'Marsh's test' for arsenic. Should it be imperfectly formed or masked by

decomposed organic matter, the portion of the tube which contains it may be cut off with a file, next coarsely powdered, then reintroduced with more reducing mixture into another tube, and the exposure to heat repeated.

The characteristics most simple and well-marked are:

(α) The volatility of the deposit when heated, which is shown by its escaping from the hotter portion of the tube and condensing on the cooler part higher up.

(β) Its conversion into minute octahedral crystals of arsenious anhydride, when repeatedly chased up and down the tube by the cautious application of the flame of a spirit lamp, first to one part and then to another. The character of these crystals with respect to volatility, lustre, transparency, and form is so exceedingly well marked that a practised eye may safely identify them, though their weight should not exceed the $\frac{1}{100}$th or even the $\frac{1}{250}$th part of a grain. A pocket lens is here serviceable. The form of the crystals is very evident with a microscope of 4 powers. Oxide of antimony never forms octahedra, but only prisms.

4. "If arsenious acid or one of its compounds is exposed on charcoal to the reducing flame of the blowpipe, a highly characteristic garlic odour is emitted, more especially if some carbonate of soda is added. This odour has its origin in the reduction and re-oxidation of the arsenic, and enables us to detect very minute quantities. This test, however, like all others based upon the mere indications of the sense of smell, cannot be implicitly relied on" (*Fresenius's* 'Qualitative Analysis'). Great care must, of course, be taken not to inhale much of these fumes.

b. Wet Tests. 1. Sulphuretted hydrogen produces in solutions of arsenic trioxide or the arsenites, which have been acidified by hydrochloric acid, a bright yellow precipitate of the trisulphide, As_2S_3, which is insoluble in dilute (and nearly insoluble in concentrated) hydrochloric acid, but soluble in yellow sulphide of ammonium (difference from cadmium sulphide); soluble also in a solution of carbonate of ammonium (difference from the sulphides of antimony and tin). Or, speaking generally, this precipitate is soluble in alkalies, alkaline carbonates, and alkaline sulphides. In pure aqueous solutions of the trioxide or of neutral alkaline arsenites, sulphuretted hydrogen only gives a yellow colouration. Alkaline solutions are not precipitated.

2. An aqueous solution of arsenic trioxide (free from chlorides) yields with ammonio-argentic nitrate a yellow precipitate of silver-arsenite, Ag_3AsO_3; with a solution of ammonio-cupric sulphate it gives a grass-green precipitate of arsenite of copper, $2CuO,As_2O_3$. In the second case the arsenic solution need not be free from chlorides; too much of the cupric solution must not be used, otherwise its blue colour would obscure the green of the precipitate. When only very small quantities of arsenic are present, the precipitates must have time given them to fall.

The ammonio-argentic nitrate is made by adding a weak solution of ammonia to a strong one of silver nitrate until the brown oxide of silver—at first precipitated—is almost re-dissolved, and then filtering.

The ammonio-cupric sulphate is made in the same manner by adding ammonia to a weak solution of sulphate of copper till the bluish-white precipitate, at first produced, is nearly re-dissolved.

3. *Reinsch's Test.* This test depends upon the fact that when to a solution of arsenic trioxide one quarter or one sixth of its volume of *pure* hydrochloric acid and a perfectly clean slip of copper foil (free from arsenic) are added, and the whole boiled in a test-tube or small basin, an iron-grey metallic film is deposited on the copper, even in very dilute solutions; when this film increases in thickness it peels off in black scales. If the coated copper, after washing off the free acid, is heated with a solution of ammonia, the film peels off from the copper and separates in the form of minute spangles; these consist, not of arsenic itself, but of an arsenide of copper. Again, if the coated copper (or scales) be washed with distilled water, dried by pressing between folds of filter-paper and heated in a subliming tube, minute octahedral crystals of arsenic trioxide will be obtained. "It is only after the presence of arsenic in the alloy has been fully demonstrated that this reaction can be considered a decisive proof of the presence of that metal, as antimony and other metals will under the same circumstances also precipitate in a similar manner upon copper" (*Fresenius*).

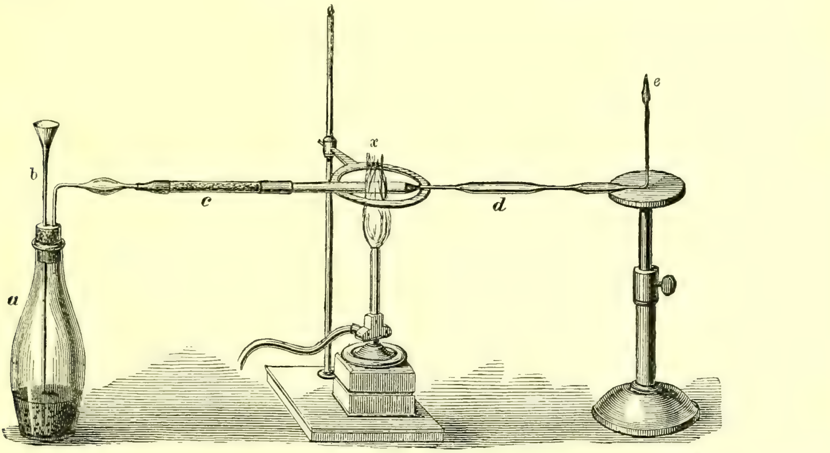
Note. The following process, suggested by Professor Abel, enables one to test quickly whether copper foil, &c., is or is not free from arsenic:—"Boil together equal parts of a solution of perchloride of iron and strong hydrochloric acid, and while boiling introduce the slip of copper, polished. If arsenic is present it is speedily indicated by a black deposit on the copper. If the metal is pure, its red colour becomes more strongly marked. All the ordinary copper foil, wire, and gauze may thus be proved to contain arsenic" ('Taylor on Poisons,' 3rd ed. p. 320).

Marsh's Test. If to a neutral solution of arsenic trioxide or any of its compounds, or of arsenic compounds generally, a little pure zinc, water, and dilute sulphuric acid be added, the arsenic present will be evolved—along with excess of hydrogen—in the form of arseniuretted hydrogen, AsH_3, just as antimonious compounds give, under similar circumstances, antimoniuretted hydrogen, SbH_3. By means of this test it is possible to detect the most minute traces both of arsenic and of antimony; the test is not only excessively delicate, but it is also easy to carry out.

The subjoined engraving shows the form of apparatus required. *a* is a small generating flask; *b* a funnel tube, the lower end of which must be well below the surface of the liquid in *a*; and *c* a drying tube filled with small pieces of chloride of calcium, and having a loose plug of cotton wadding at either end to prevent the chloride from falling out. *d* is a plain glass tube of about 7 mm. internal diameter (preferably made of difficultly fusible Bohemian glass, not of lead glass), which may either be uniform in diameter throughout, or be somewhat constricted—by means of the blow-pipe—at one or two points, as shown in *engr.*; towards its end it is bent at right angles, the orifice at *e* being a very small one. The corks and the joints must, of course, be

perfectly tight, and the india-rubber tubing used for the latter (black tubing for choice) should be previously boiled in a solution of soda.

The apparatus having been fitted up, the next thing to do is to test the various reagents for their purity, *i. e.* freedom from arsenic and antimony. A blank experiment is therefore made with as much zinc, sulphuric acid, and water alone as will be afterwards required in the actual testing, and the presence or absence of arsenic and antimony in them demonstrated in the manner about to be described. The zinc and acid having been found to be pure, the test is made as follows:—A little water and a few pieces of zinc being placed in *a*,



dilute sulphuric acid is run in through the funnel, when the evolution of hydrogen commences; should this evolution not be brisk enough, the addition of a few drops of a solution of platinic chloride or copper sulphate will make it so. After the gas has come off for a few minutes, and the observer judges that all air has been driven out of the apparatus, the arsenic or antimony solution is run in through the funnel *b*, and the escaping jet of hydrogen gas lit at *e*. (*Note.*—Unless the air has been driven out, an explosion will follow on applying a light to *e*, and the whole apparatus will probably be shattered, not to mention the possible danger to the experimenter. It is advisable to wrap a piece of cloth round the flask before kindling the gas.)

The arsenic or antimony will now be evolved as arseniuretted or antimoniuretted hydrogen, along with the excess of hydrogen itself, and can be detected in the two following ways:

1. Any point of the evolution tube—say *x*—is strongly heated by the flame of a *Bunsen* burner or spirit lamp (care being taken that the heat be not so great as to cause the glass to soften much, if at all), when, if arsenic be present in the escaping gas, a black metallic mirror will form in the tube *a short distance in front* of the point of heating; whereas, in the case of antimony, the mirror will be *almost over that point* (antimony being the less volatile of the two). In this way, should there be more than a mere trace of the metal, various deposits can be got by heating the tube at different points. The arsenical mirror is of a darker and less silvery-white hue than that produced by antimony, and it can further be distinguished from the latter by the ease with which it may be dissipated on heating it in a current of hydrogen gas.

2. A small porcelain basin or crucible lid, which must be cold, is depressed for a moment over the flame at *e*, so that the latter is spread out horizontally over its surface. This must be done repeatedly, but only for a second at a time, and the porcelain should not be allowed to get very hot. Should arsenic or antimony be present, small brown to black stains will be deposited on the porcelain. The stains produced by arsenic are brownish or brownish-black, and with a high metallic lustre, those of antimony being darker and almost lustreless. It is not, however, safe to attempt to discriminate between them by their appearance alone, but this can be done with the utmost facility by touching each stain with a drop of a fresh aqueous solution of bleaching powder, made with cold water, when those of arsenic will immediately dissolve, the antimony stains remaining unaffected. A solution of hypochlorite of sodium (prepared by adding the requisite amount of sodic carbonate to the solution of bleaching powder, and filtering off the precipitated carbonate of lime) is preferable to one of bleaching powder itself. The above tests (1 and 2) ought always to be made together. They enable us to distinguish with certainty between arsenic and antimony stains, but they will often fail to detect arsenic in presence of antimony. In cases of this kind the following process—as given by Fresenius in his 'Qualitative Analysis'—"will serve to set at rest all possible doubt as to the presence or absence of arsenic:"

"Heat the long tube, through which the gas to be tested is passing, to redness in several parts, to produce distinct metallic mirrors; then transmit through the tube a very weak stream of *dry* sulphuretted hydrogen gas, and heat the metallic mirrors, proceeding from the outer towards the inner border. If arsenic alone is present, yellow tersulphide of arsenic is formed inside the tube;

if antimony alone is present, orange-red or black tersulphide of antimony is produced; and if the mirror consists of both metals, the two sulphides appear side by side, the sulphide of arsenic—as the more volatile—lying invariably before the sulphide of antimony. If you now transmit dry hydrochloric acid gas through the tube containing the sulphide of arsenic or the sulphide of antimony, or both sulphides together, without applying heat, no alteration will take place if sulphide of arsenic alone is present, even though the gas be transmitted through the tube for a considerable time. If sulphide of antimony alone is present, this will entirely disappear; . . . and if both sulphides are present, the sulphide of antimony will immediately vanish, whilst the yellow sulphide of arsenic will remain. If a small quantity of ammonia is now drawn into the tube, the sulphide of arsenic is dissolved, and may thus be readily distinguished from sulphur which may have separated. My personal experience has convinced me of the infallibility of these combined tests for the detection of arsenic."

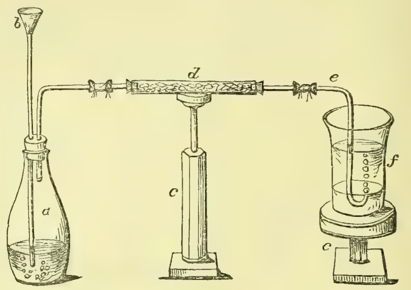
An experienced observer can detect the difference in appearance between a flame of hydrogen alone, and one of hydrogen containing (an appreciable quantity of) arseniuretted hydrogen, the latter having a slightly violet colour; when antimoniuretted hydrogen is present, the flame acquires a bluish tinge. Both gases being intensely poisonous, the experiments just described should be conducted in an acid chamber with a good draught; and only *very minute* quantities of arsenic and antimony compounds should be worked with. The theory of the formation of arseniuretted and antimoniuretted hydrogen, and of the production of the arsenic and antimony mirrors, is extremely simple. The arsenic trioxide (for example) is reduced by the nascent hydrogen from the zinc and sulphuric acid thus:

$$As_2O_3 + 6H_2 = 2AsH_3 + 3H_2O.$$

When the tube through which the gas passes is strongly heated, or when the escaping jet is kindled, the arseniuretted hydrogen is decomposed into arsenic and hydrogen, the arsenic being deposited either on a cooler portion of the tube or on the cold porcelain.

Lassaigne's Test (adopted by the French Academy). This consists in passing the gas, generated—as in Marsh's test—in the suspected liquid, through a solution of nitrate of silver (see *engr.*). When arsenic is present, black flocculi of metallic silver are deposited, and arsenious acid remains in solution mixed with nitric acid and some arsenide of silver. The filtered liquor, treated with ammonia, will now give a characteristic yellow precipitate of arsenite of silver; or a little dilute hydrochloric acid may be cautiously added to precipitate any remaining nitrate of silver, and the liquid, after filtration, tested for arsenic either in a Marsh's apparatus, or by any of the liquid tests; or it may be evaporated to dryness, when its arsenious acid will be converted into arsenic acid by the nitric acid present, and this will then be found to give the usual brick-red precipitate of arseniate of silver with a solution of the nitrate of that metal.

Arsen'ic Pentoxide, As_2O_5. *Syn.* ARSEN'IC OXIDE, ARSEN'IC ANHYDRIDE, ANHYDROUS ARSENIC ACID, ARS'ENIC ACID; ACIDUM ARSENICUM, L.; ACIDE ARSÉNIQUE, Fr.; ARSENSÄURE, Ger. Mol. wt. unknown.



a. Bottle containing dilute sulphuric acid, zinc, and suspected fluid.
b. Funnel for supplying the bottle with acid.
c, c. Supports.
d. Tube filled with asbestos.
e. Bent tube to convey the liberated gas.
f. Glass vessel containing a solution of nitrate of silver.

Prep. and Prop. Unlike phosphorus, metallic arsenic burns in the air only to the trioxide. The pentoxide is prepared by heating arsenic acid (which *see*) to a moderate temperature, when it is left behind as a white porous mass, thus:

$$2H_3AsO_4 = As_2O_5 + 3H_2O.$$

It absorbs water from the air, with the formation of the acid, $H_3AsO_4 + H_2O$, and dissolves slowly—but to a considerable extent—in water. When heated to a temperature above low redness it melts, giving off oxygen and leaving the trioxide. It is readily reduced on heating with charcoal, &c.

The Ars'enic Acids.

Ortho-arsen'ic Acid, H_3AsO_4, or $AsO(OH)_3$. *Syn.* ACIDUM ARSEN'ICUM, L.; ACIDE ARSÉNIQUE, Fr.; ARSENSÄURE, Ger.

Prep. (*a*) On the large scale, by warming arsenic trioxide with nitric acid.

(*b*) On the small scale the following proportions may be used:

1. Arsenious acid, in fine powder, 2 parts; concentrated nitric acid, 6 parts; hydrochloric acid, 1 part; mix in a flask or tubulated retort, and digest, with heat, until solution is complete; after repose, decant the clear portion and evaporate to the consistence of a thick syrup.

2. Dissolve arsenious acid in hot hydrochloric acid, and when the solution is cold add concentrated nitric acid, in small quantities at a time, until red vapours cease to be evolved; then proceed as before.

The arsenic acid of commerce is a thick liquid of 1·2 sp. gr. It deposits, when cooled, transparent crystals of the formula $2H_3AsO_4 + H_2O$. These melt at 100° C., giving off water, and leaving the anhydrous ortho-arsenic acid, H_3AsO_4, as a crystalline powder. Arsenic acid has an unpleasant metallic taste, and is poisonous, though not so poisonous as arsenious acid. Heated to 180° C., ortho-arsenic acid loses water, going into PYRO-ARSENIC ACID, $H_4As_2O_7$, while this latter loses more water at 200°, yielding META-ARSENIC ACID, $HAsO_3$, thus:

$$2H_3AsO_4 - H_2O = H_4As_2O_7;$$
$$H_4As_2O_7 - H_2O = 2HAsO_3.$$

Both the latter acids dissolve in water with the evolution of heat, going thereby into the orthoacids (cf. the PHOSPHORIC ACIDS).

Arseniates or **Arsenates** (only the ortho-arsenates need be mentioned here). *Prep.* Most of the metallic arseniates may be formed by adding a solution of a soluble salt of the metal to another of an alkaline arseniate, as long as a precipitate falls; this is then collected, washed, and dried. The alkaline arseniates may be prepared by adding the base or its carbonate to a solution of the acid until the liquid is alkaline, and then evaporating and crystallising.

Prop., &c. The arseniates of the alkalies are soluble in water; those of the alkaline earth and other metals insoluble in water, but soluble in acids. They are isomorphous with the corresponding phosphates.

Tests for. 1. Sulphuretted hydrogen does not precipitate either alkaline or neutral solutions, and in acidified solutions—*in the cold*—it gives rise to no precipitate at first. On long standing, however, reduction to arsenious acid takes place, with separation of sulphur, and then trisulphide of arsenic is precipitated. At a temperature of 70° C. a yellow precipitate of the pentasulphide, As_2S_5, is produced (see Fresenius's 'Qualitative Analysis').

2. Nitrate of silver added to the solution of an arseniate gives a highly characteristic reddish-brown precipitate of arsenate of silver, Ag_3AsO_4; the solution should be free from hydrochloric acid and chlorides.

3. Sulphate of copper produces no precipitate in an aqueous solution of arsenic acid. On adding an alkali, a greenish-blue precipitate of arsenate of copper is formed, which dissolves in excess of the precipitant to a pale blue liquid.

4. If to a solution of arsenic acid, or a soluble arsenate, a clear mixture of sulphate of magnesium, chloride of ammonium, and excess of ammonia is added, a crystalline precipitate of magnesium-ammonium arsenate is produced (cf. TESTS FOR ORTHO-PHOSPHORIC ACID).

5. If a solution of arsenic acid is treated with sulphurous acid and boiled for a short time, it is reduced to arsenious acid, which may be tested for as such.

6. Heated with charcoal, or any suitable reducing mixture in a subliming tube, the acid and its salts are reduced, giving rise to a garlic-like odour (cf. test No. 3 for the trioxide).

Arsenic, Halogen Salts of.

Arsenic Tribro′mide, $AsBr_3$. *Syn.* TERBRO′MIDE OF ARSENIC, SESQUIBRO′MIDE OF A.; ARSEN′ICI BROMI′DUM, L. *Prep.* 1. Add metallic arsenic, in powder, cautiously and in very small quantity at a time, to pure bromine, contained in a vessel set in ice or a freezing mixture, until light ceases to be emitted; then cautiously distil into a well-cooled receiver.

2. Powdered metallic arsenic is added to a solution of 1 part of bromine in 2 parts of carbon bisulphide until the solution becomes colourless. Then bromine and arsenic are added alternately until the colour of the first disappears; the liquid is poured off clear, and the bisulphide allowed to evaporate spontaneously.

Prop., &c. Colourless deliquescent crystals below about 20° C.; above that temperature a yellowish fuming liquid, which boils at 220° C. Like the chloride it is decomposed by water.

Arsenic Trichlo″ride, $AsCl_3$. *Syn.* CHLO″RIDE OF A.; ARSEN′ICI TERCHLORI′DUM, &c., L. *Prep.* 1. One part of white arsenic and 6 of bichloride of mercury, both powdered, are mixed together and carefully distilled, when arsenic trichloride passes over.

2. A stream of chlorine is cautiously passed over heated metallic arsenic, which thus burns to the chloride; in order to purify it from excess of chlorine, it must be passed over some more arsenic.

3. Gently boil powdered white arsenic for some time in hydrochloric acid to which a little nitric acid has been added; then concentrate cautiously by evaporation, and distil as before.

Prop., &c. A colourless, volatile, highly poisonous liquid, which forms needles of arsenic oxychloride, $As(OH)_2Cl$, with a small quantity of water, but is decomposed by a large quantity into arsenic trioxide and hydrochloric acid. "When the solution is distilled, arsenic trichloride comes over together with the vapour of water; this explains the fact that the hydrochloric acid prepared from arsenical sulphuric acid invariably contains arsenic" (Roscoe and Schorlemmer's 'Chemistry,' vol. i, p. 522). It has been employed as a caustic in cancer and venereal warts; but its use requires the greatest caution.

Arsenic Triflu′oride, AsF_3. A fuming, volatile, and highly dangerous liquid.

Arsenic Triiodide, AsI_3. *Syn.* TERIODIDE OF ARSENIC, IODIDE OF ARSENIC; ARSEN′ICI IODI′DUM, A. TERIODI′DUM, L.; ARSENIC IODURE, &c., Fr.

Prep. 1. Similar to that of the tribromide, using bisulphide of carbon.

2. Two parts of finely powdered metallic arsenic and 11 parts of iodine are *cautiously* mixed (much heat being given out by the combination) and gently heated in a bent glass tube, or a suitable retort, until combination is complete; the temperature is then raised, and the sublimed iodide collected, and at once put into a well-stoppered phial.

3. Arsenic, in fine powder, 1 part; iodine, 5 parts; triturate them together, place the mixture in a small flask or retort just large enough to contain it, and apply a gentle heat until liquefaction is complete, avoiding the formation of iodine vapour; when the odour of iodine is no longer perceptible, and the mass assumes a reddish-yellow colour and crystallises on the sides of the vessel, the operation is complete, without sublimation being required. A very easy and excellent process.

It may again be emphasised here that in the preparation of arsenic, or of any of its compounds, the operation should be conducted underneath a flue with a good draught, so that the operator shall not inhale any of the fumes.

Prop., &c. A deep orange-red crystallisable solid; soluble in water, and highly volatile and poisonous. It dissolves in about 3½ parts of boil-

ing water, and this solution yields the iodide unchanged if rapidly evaporated, but when slowly concentrated and set aside, white pearly plates are obtained, consisting of arsenious acid and the oxy-iodide. As a medicine it combines the properties of both arsenious acid and iodine, but its use requires great caution. It has been successfully employed by Dr A. T. Thomson, Biett, and others, in obstinate skin diseases (lepra, impetigo, herpes, lupus, psoriasis, &c.), and in real or simulated cancer.—*Dose*, $\frac{1}{16}$ to $\frac{1}{12}$ gr. (in pills or solution), gradually increased to $\frac{1}{8}$ or even $\frac{1}{3}$ gr. (*A. T. Thomson*). Externally, $2\frac{1}{2}$ gr. to lard 1 oz.; of which 1 dr. may be used at a time (*Biett*).

Arsenic, Sulphides of. Three definite compounds of arsenic and sulphur are known, viz.:

Arsenic disulphide or realgar, As_2S_2;

Arsenic trisulphide or orpiment, As_2S_3;

Arsenic pentasulphide, As_2S_5.

The last two of these correspond to the two oxides. They act as acid-forming sulphides, and give rise to well-defined series of salts, the thio-arsenites and thio-arsenates.

Arsenic Disulphide, As_2S_2. *Syn.* ARSENIC BISULPHIDE, BISUL'PHIDE OF A., RED SUL'PHIDE OF A., &c., REALGAR; RÉALGAL, ARSENIC ROUGE SULFURE, ORPIN ROUGE, &c., Fr.; ROTHES SCHWEFELARSENIK, &c., Ger. This substance is found native at Solfaterra, near Naples, and in several other volcanic districts. It crystallises in orange-yellow oblique rhombic prisms belonging to the monoclinic system. The realgar of commerce, also known as red arsenic glass or ruby sulphur, is prepared by distilling arsenical pyrites, or a mixture of sulphur and arsenic, of orpiment and sulphur, or of arsenic trioxide, sulphur, and charcoal, in the proper proportions. In Freiberg (Saxony), where arsenical pyrites and common pyrites are used, the proportions are such that the mixture contains about 15% of arsenic and 27% of sulphur. Such a mixture is then sublimed in a furnace in which are placed twelve iron tubes, each holding about 30 kilos. of ore, and the charge is renewed every twelve hours. In order to give the product the right degree of colour, it is again melted with sulphur.

Prop., *Uses*, *&c.* Arsenic disulphide is a fusible, volatile substance, scarlet or ruby-red in mass, but orange-red in powder, by which it is distinguished from cinnabar; sp. gr. 3·3 to 3·6. The commercial product manufactured at Freiberg contains generally 75% of arsenic and 25% of sulphur; while that made at Reichenstein, in Silesia, is a mixture of 95% disulphide and 5% of sulphur. It was formerly much used as a pigment, and is still employed for making Indian or white fire, which is a mixture of 2 parts of the disulphide with 24 parts of nitre, and burns with a splendid white light when ignited. Mixed with lime, it is employed in tanning, to remove the hair from skins. The artificial sulphide has not the rich colour of the native mineral, whilst it is much more poisonous. It is improved by re-sublimation.

Arsenic Trisulphide, As_2S_3. *Syn.* TERSUL'PHIDE OF ARSENIC, YELLOW SUL'PHIDE OF A., SESQUISUL'PHIDE OF A., OR'PIMENT; A. SESQUISULPHURE'TUM, ORPIMEN'TUM, L.; ORPIMENT, SULFURE JAUNE D'ARSENIC, &c., Fr.; AURIPIGMENT, OPERMENT, RAUSCHGELB, Ger. This sulphide is likewise found native, crystallised in lemon-coloured rhombic prisms belonging to the monoclinic system; sp. gr. 3·46. The commercial product is prepared artificially by subliming a mixture of 7 parts powdered trioxide with 1 part of sulphur; it is really a mixture of trioxide (up to 80% to 90%) with more or less sulphide, and is very poisonous. The precipitation of this sulphide from an acid solution of the trioxide by means of sulphuretted hydrogen has already been gone into.

Prop. and Uses. Golden-yellow crystalline lumps, or a fine golden-yellow powder. For solubility, &c., see ARSENIC TRIOXIDE, TESTS FOR. It was formerly much used as a pigment, under the name of King's Yellow, but is now almost entirely superseded by the comparatively innocuous chrome yellow. It is still employed for various purposes, *e.g.* in the printing of indigo colours, and a mixture of orpiment, lime, and water is used in the East as a depilatory under the name of *Rusma*.

As already mentioned, arsenic trisulphide acts as an acid-forming sulphide, giving rise to salts, the thio-arsenites. This will be made evident from its analogy to the trioxide, as shown in the two following equations:

$$\underset{\text{Potassic oxide.}}{3K_2O} + \underset{\text{Arsenic trioxide.}}{As_2O_3} = \underset{\text{Potassic arsenite.}}{2K_3AsO_3}$$

$$\underset{\text{Potassic sulphide.}}{3K_2S} + \underset{\text{Arsenic trisulphide.}}{As_2S_3} = \underset{\text{Potassic thio-arsenite.}}{2K_3AsS_3}$$

Thus, when the trisulphide is dissolved in an alkaline sulphide, the corresponding thio-arsenite is formed; this is decomposed by acids, with re-precipitation of the trisulphide, thus:

$$2K_3AsS_3 + 6HCl = As_2S_3 + 6HCl + 3H_2S.$$

Arsenic Pentasul'phide, As_2S_5. *Syn.* SULPHARSEN'IC ACID, &c.; ARSEN'ICI PENTASULPHURE'TUM, &c., L. Under certain conditions, sulphuretted hydrogen throws down the pentasulphide from a solution of arsenic acid. In colour it resembles the trisulphide. Like the latter, too, it is an acid-forming sulphide, giving rise to salts, the thio-arsenates (analogous to the arsenates); *e.g.* potassium thio-arsenate, K_3AsS_4. More than one series of these is known.

Arsenic, Estimation of. The method to be chosen for estimating arsenic depends upon whether it is present in solution in the state of trioxide (or an arsenite), or in that of pentoxide (or an arseniate). If it be wished to convert the trioxide into the pentoxide, this can be done by *gently* warming its solution in a roomy flask with hydrochloric acid, and adding potassium chlorate in small portions at a time until the liquid smells strongly of chlorous acid; after this the moderate heat is continued until the smell of the latter has become but weak. The reader must bear in mind that a solution of the trioxide in hydrochloric acid cannot be concentrated by evaporation, since vapours of the trichloride escape along with the excess of acid.

(*a*) *The Arsenic is in Solution as Trioxide.*

(A) GRAVIMETRIC METHODS. (1) *Estimation as trisulphide.* The slightly warmed solution, which has been strongly acidified with hydrochloric acid, is saturated with sulphuretted hydrogen gas, and the excess of this driven out by carbonic acid.

The precipitated trisulphide is then filtered through a weighed filter, washed quickly with water to which a few drops of sulphuretted hydrogen solution have been added, and dried at 100° C. until the weight is constant. The precipitate may contain a little free sulphur, and therefore it is advisable to treat a weighed portion of it with fuming nitric or nitro-hydrochloric acid until all the sulphur is oxidised to sulphuric acid, which is then estimated as barium sulphate ($BaSO_4$) in the usual manner (see SULPHUR AND SULPHURIC ACID, ESTIMATION OF). The slight calculation which this involves suffices to show whether the trisulphide was free from sulphur or not:

246 parts by weight of As_2S_3 contain 96 parts by weight of S.

233 parts by weight of $BaSO_4$ contain 32 parts by weight of S.

(2) *Estimation as magnesium-ammonium arseniate.* All the arsenic present is oxidised to the state of pentoxide (see *above*), and this then estimated in the manner detailed below.

(B) MOHR'S VOLUMETRIC METHOD. This method depends upon the fact that an aqueous solution of arsenious acid or of an alkaline arsenite, when mixed with an excess of sodium bicarbonate, is oxidised to arsenic acid by a solution of iodine, thus:

$$As_2O_3 + 2Na_2O + 2I_2 = As_2O_5 + 4NaI.$$

A convenient solution of iodine is prepared by dissolving 6·2 to 6·3 grms., with the aid of 9 grms. pure potassic iodide, in about 1200 c.c. water; this must of course be standardised by means of a solution of sodium thiosulphate ($Na_2S_2O_3$) before use (see CHLORIMETRY). To a solution containing about 0·1 grm. of trioxide some 20 c.c. of a saturated solution of pure bicarbonate of sodium, together with a little starch solution, are added, and the iodine solution run in from a burette (with *glass* stopcock) until the characteristic blue colour of iodide of starch just remains permanent. If the arsenious solution is acid to begin with, it must before titration be neutralised with pure sodic carbonate, and if alkaline, with pure hydrochloric acid. 508 parts by weight of free iodine oxidise 198 parts by weight of arsenic trioxide (As_2O_3). The results are accurate when no other substances (*e.g.* sulphurous acid) capable of being oxidised by the iodine are present in the liquid.

(β) *The Arsenic is in Solution as Pentoxide.* (1) *Estimation as magnesium-ammonium arseniate,* $MgNH_4AsO_4 + 6H_2O$. The solution is precipitated with magnesia mixture, exactly as in the case of phosphoric acid (which *see*), and left to stand in a covered beaker overnight. The precipitate is then collected on a weighed filter and washed with dilute ammonia (1 in 4), after which it is either dried *in vacuo* over sulphuric acid, when it retains all its water of crystallisation; or it is dried more expeditiously at 100°, when it loses $\frac{11}{12}$ths of its water, leaving the salt $MgNH_4AsO_4 + \frac{1}{2}H_2O$. From either of these the amount of arsenic found is readily calculated: 578 parts by weight of $MgNH_4AsO_4 + 6H_2O$, or 380 parts by weight of $MgNH_4AsO_4 + \frac{1}{2}H_2O$, are equivalent to 230 parts by weight of As_2O_5.

(2) *Estimation as trisulphide* (As_2S_3). Sulphuretted hydrogen is passed through the solution, *heated to about* 70° *C.*, as above, so long as a precipitate forms. The precipitate consists of a mixture of the trisulphide and sulphur, the latter being present owing to the reduction of the arsenic acid, thus: $As_2O_5 + 2H_2S = As_2O_3 + 2H_2O + S$). It is filtered and washed, and treated, while still moist, with a solution of ammonia, which dissolves the trisulphide, leaving nearly all the sulphur undissolved. The solution is then re-precipitated by excess of hydrochloric acid, and the trisulphide filtered, washed, and dried as before. It contains a little sulphur, but this can be checked by the method already detailed.

Detection of Arsenic in Organic Mixtures. The tests for arsenious acid, which have already been given in more or less detail, presuppose for the most part that the trioxide is either in the solid state, or in a solution free from organic matter. Now, in cases of poisoning by arsenic, we have usually to deal only with a very small quantity of the latter, mixed with an enormous excess of organic matter. It would be out of place here to enter into minute details regarding the detection of arsenic in poisoning cases (for which the reader is referred to 'Taylor on Poisons'), but a few words may be said on the subject. It should not be forgotten, however, that it requires an expert to undertake the investigation of such a case. Of the tests given, those which act by producing coloured precipitates are only applicable, with any degree of certainty, to perfectly limpid and colourless liquors, free from organic matter. Those depending on the evolution of arseniuretted hydrogen are partially free from this inconvenience; but even here, if the suspected liquid be more than slightly charged with organic matter, so much frothing ensues as to render the process nearly unmanageable. In this respect Reinsch's test possesses advantages over all others, as it may be applied even to coloured liquids containing a considerable quantity of organic matter, without these being subjected to any preliminary process, and without danger of failure. Liquids rich in organic matter require longer boiling with the copper than those nearly free from it. When the quantity of arsenic in the suspected liquid is very small, at least *half an hour* should elapse before the removal of the copper.

This test is invaluable as affording a certain and ready means of abstracting arsenic from its solution, whether pure or mixed with organic matter. The contents of the stomach or other viscera may thus be at once examined, without any tedious preliminary operations. In this way Dr Christison discovered the presence of arsenic upwards of four months after interment. The coated copper may be preserved unharmed for years. Dr Taylor found that the 1-8th of an inch in one of these deposits that had been kept in paper nearly fourteen years gave a well-marked ring of octahedral crystals (of As_2O_3) when heated in a subliming tube.

In some cases also, as with liquids possessing only a slight degree of consistency or colour, the arsenic may be separated, after simple filtration and acidulation with hydrochloric acid, by a stream of sulphuretted hydrogen, in the usual

manner. The reduction-test is only applicable to solid arsenious acid, or to compounds of arsenic obtained by means of other tests or processes. In toxicological examinations the poison is almost always to be sought for in mixtures loaded with organic matter, and under other conditions even more embarrassing. Soon after arsenic is swallowed it enters the circulation, contaminates the various tissues, localises itself in certain viscera, and is eliminated in the excretions. Hence it becomes necessary not only to examine the solids and liquids in which it is suspected the poison has been administered, the vomited matter, and the contents of the stomach and primæ viæ, but also, in fatal cases, the stomach itself, the liver, blood, muscles, and more especially the urine. Absorbed arsenic more particularly localises itself in the liver, in which it may generally be found in from twelve to fifteen hours after administration. The liver also generally retains traces of arsenic long after it has been eliminated from the other viscera and the muscular tissues. In such cases the stomach is the part first laid open, and a careful examination is made of its contents and coats in order to detect any undissolved particles of the poison, a pocket lens being employed, if necessary, in the search. If any particles, however minute, are found they are carefully collected and submitted to the reduction-test. If the reverse be the case, the stomach (cut into small pieces), together with its contents, is submitted to some further process, to obtain a solution suitable for the application of the usual tests. The liver, also some muscle, and any other portion of the body that may be selected, are likewise separately treated in the same manner. We have here both solid and liquid organic matter to operate on, and the problem for solution is the abstraction of their arsenic in the simplest and most certain manner, and in a form in which its presence may be demonstrated by tests. This subject has long engaged the attention of the most eminent chemists and toxicologists, and various plans have been proposed for the purpose, among which the following, given in Taylor's 'Medical Jurisprudence' (*Stevenson*), 3rd ed., vol. i, is probably the best:

"About 4 oz. of the recent organ, or more if necessary, cut into very thin slices, should be boiled in a flask in a mixture of 1 part of pure hydrochloric acid, and 2 of water, until the structure of the organ is broken up. The flask should have a fairly wide neck, and either a naked gas or spirit flame, or a sand-bath may be employed for heating it. A small glass funnel should be placed in the neck of the flask. This receives and condenses the vapour, which falls back into the flask. By this arrangement the boiling may be continued for a long time without material loss by evaporation. The flask should not be more than half full, and heated gently until all froth is expelled. A slip of fine platinum wire, having a small piece of *pure* copper foil or gauze attached, should be immersed in the liquid when boiling. This enables the operator to remove the copper and examine it at intervals, after immersing it in distilled water. If it is much coated with a metallic deposit, larger portions of copper foil may be successively introduced until the liquid is exhausted. The deposits on the copper may be tested by the methods already described. This process will detect arsenic in the urine and saliva eliminated from the living body, and in all liquid articles of food. When hydrochloric acid is diluted with this proportion of water, little or no volatile arsenic terchloride distils over. In reference to the *recent* organs, a larger proportion of acid is used because three fourths of the weight of the animal substance really consist of water."

"The method of Fresenius and Babo is preferable to all others for the destruction of organic matters, and the obtaining of arsenic from organic mixtures, the solid organs, &c. The substance to be examined—if a solid, finely shred—is placed in a porcelain dish, and treated with a quantity of hydrochloric acid of the sp. gr. 1·12 equal to, or rather exceeding, the weight of the dry substances present, and sufficient water to give the entire mass the consistence of a thin paste. The quantity of hydrochloric acid should never exceed one-third of the entire liquid present. Heat the dish on a water-bath, adding from time to time —say every five minutes—2 gr. of potassium chlorate for every fluid ounce of liquid in the dish, with stirring, until the contents of the dish are light yellow in colour, homogeneous, and fluid. A further addition of hydrochloric acid may be requisite, when much chlorate is added, for the destruction of the organic matters. The operation is completed when the liquid, after a fresh addition of either chlorate or acid, does not deepen in colour when heated anew on the water-bath for a quarter of an hour. When this point is attained, add again a little chlorate, and then cool the dish. When quite cold, strain the contents through linen or a filter, wash, and heat the filtrate on the water-bath with renewal of the evaporated water, until all odour of chlorine, or nearly so, has disappeared. The liquid thus obtained, measuring about thrice the bulk of the hydrochloric acid employed, is transferred to a flask and heated to from 150° F.—160° F., and a slow stream of washed sulphuretted hydrogen gas is passed through it for twelve hours. The flask is then cooled with continual transmission of the gas. The stream of gas is now suspended; and the flask is set aside, lightly covered, in a warm place (85° F.—90° F.) until the odour of sulphuretted hydrogen has nearly disappeared. Any precipitate which forms is collected on a filter, and washed with water containing sulphuretted hydrogen until the washings are quite free from chlorides. The precipitate contains the arsenic, and also any antimony, mercury, lead, or copper, which may be present, and free sulphur."

This precipitate may be examined in the ordinary way, or by the special methods detailed in Dr Stevenson's work above referred to.

An excellent and simple test is that of Gutzeit. Place 5 c.c. of dilute hydrochloric acid and 15 to 20 drops of the fluid to be tested in a long narrow test-tube, with about 1 grm. of pure zinc. Prepare a cap of filter-paper, place on its centre 1 drop of strong solution of mercuric chloride, allow it to dry, then place the cap over the mouth of the tube. In the presence of $\frac{1}{100}$th of a milligramme of arsenic, a distinct yellow stain will be

produced on the surface of the paper in fifteen minutes, whilst $\frac{1}{50}$th of a milligramme will give the same result in a few minutes.

Reinsch's test is inapplicable when, as sometimes happens, the arsenic sought after may be in the state of one of the sulphides—either as orpiment or realgar—a not improbable contingency, when it is remembered that, although arsenious anhydride or white arsenic is the form most generally used for criminal or suicidal purposes, the yellow and the red varieties being largely employed in workshops wherefire works are manufactured, have not unfrequently been had recourse to. Again, when the examination of a corpse long buried and disinterred takes place, it must be borne in mind that the arsenious anhydride taken by the deceased has, by the decomposition of the body, become converted into sulphide. In these cases the hydrochloric acid necessary for the performance of Reinsch's test fails to effect the solution of the sulphide.

Mr Blyth says: "It is found that the post-mortem change into orpiment is never quite complete, so that for the detection of arsenic in solid organic substances, such as the tissues of the body, the best general method is most decidedly to convert the arsenic, if present, into the volatile chloride; and, according to Dr Taylor, there is always sufficient arsenic (if present at all) unchanged into sulphide to ensure success. The only necessary caution is that the substance be thoroughly dried, and that the reagents be pure. After drying it is placed in a retort with fuming hydrochloric acid, and slowly distilled by the heat of a sand-bath. The distillate contains chloride of arsenic (if arsenic was present), and may be submitted to further tests."

Phys. Eff., &c. Arsenious anhydride or white arsenic is alike destructive to vegetable and animal life. Seeds soaked in any but a very weak solution of it lose their power of germination, and buds plunged in it become incapable of expanding into flowers. When applied to the leaves, roots, or stems, absorption takes place, and the plant soon perishes. On combustion it evolves the characteristic garlic-like odour of arsenic, and arsenic may be discovered in its substance by chemical tests. According to Jäger, Gilgenkrantz, and Pereira, a few of the lower order of the algæ are occasionally developed in solutions of arsenious acid. To all animals, from the infusoria up to man, arsenic proves deleterious, although in different degrees, the highest susceptibility of its effects existing in man on account of the superiority of his development. In all of them death is preceded by inordinate actions and increased evacuations, especially from the mucous surfaces. Difficult respiration, thirst, vomiting, and convulsions are the leading symptoms which gradually develop themselves as we approach the higher grades of the system (*Jäger*). In very small or therapeutical doses, properly administered, it is a valuable medicine, and acts as a tonic, alterative, and antispasmodic attenuant, and externally as an escharotic. In slightly increased medicinal doses, or long-continued small doses, nausea, vomiting, purging, griping, debility, emaciation, and all the effects of slow-poisoning, occur in succession—a gradual sinking of the powers of life, without any violent symptom; a nameless feeling of illness, failure of the strength, an aversion to food and drink, and to all the enjoyments of life. Redness of the conjunctiva and eyelids, headache and giddiness, spasms, eczematous eruptions, numbness and paralysis of the limbs, and ptyalism, are also frequent and well-marked symptoms of slow poisoning by arsenic. In an excessive or poisonous dose the symptoms are rapid and violent, usually indicating extreme gastro-intestinal inflammation and disorder of the cerebro-spinal system, and often occasioning death in from one to three days. The smallest fatal dose found recorded by Christison is $4\frac{1}{2}$ gr., taken in solution. The subject was a child four years old, and death occurred in six hours. $2\frac{1}{2}$ gr. destroyed a robust girl in thirty-six hours (*Letheby*). 2 gr., in solution, are suspected to have caused the death of a full-grown woman. 2 or 3 gr. may be a fatal dose (*Dr A. Taylor*). Notwithstanding these facts, much larger quantities have been taken, under peculiar circumstances, with comparative impunity; and cases are not wanting in which even enormous quantities have produced very trifling effects.

The dose for animals is—CATTLE, 5 to 10 gr. HORSE, 5 to 10 gr. SHEEP, 1 to 2 gr. PIG, $\frac{1}{2}$ to 2 gr. DOG, $\frac{1}{15}$th to $\frac{1}{10}$th gr.

Under all circumstances arsenious anhydride is, undoubtedly, one of the most powerful of the mineral poisons; and in whatever form or way it is introduced into the system it exerts the same deleterious influence. In all cases, in sufficient doses, its action is to increase the secretions, diminish the contractility of the voluntary muscles, and to produce convulsions, prostration, and death.

Arsenic is classed as a metallic irritant poison, though its action is by no means limited to that of an irritant. It acts especially on the gastro-intestinal mucous membrane, whatever be the channel by which it gains access to the system (*Taylor*).

Pois., &c.—Symp. These sometimes begin to appear within half an hour after the poison has been taken, or even sooner; but much more generally, not until after the lapse of some hours. They usually commence with nausea and distress at the stomach, followed by thirst, often intense, and a sense of burning heat in the bowels; then come on constriction of the œsophagus, violent vomiting, severe colic pains, tenesmus, and excessive and painful purging, the stools being occasionally bloody; but pain, vomiting, &c., do not invariably occur. The pulse is generally quick, small, feeble, and irregular—sometimes scarcely perceptible, and the heart's action is irregular and tumultuous. The tongue is dry and furred; the respiration difficult and panting; the urino-genital apparatus is often affected; there is pain and difficult micturition, and sometimes entire suppression of urine; faintings, coldness of the limbs, and cold sweats, with other signs of debility, intervene. Itching and eczematous eruptions of the skin, trembling, painful cramps, and contractions of the extremities, and violent convulsions often follow; and after these a greater or less prostration of strength, which induces a deceitful calm. At length the heart's action

abates, the skin becomes suffused with a cold clammy sweat, and the sufferer dies from exhaustion. The progress, succession, and precise character of the symptoms are modified by the idiosyncrasy of the individual, the quantity of the poison, and the manner in which it has been taken, and are seldom all present in the same person.

Treatment. If vomiting has commenced it should be promoted by tickling the throat, and administering a large quantity of gelatinous hydrated peroxide of iron, or other appropriate antidote, in divided doses, mixed with a large quantity of warm or tepid water, strongly sweetened with sugar. If vomiting has not commenced, which is rare, it must be excited by administering 15 to 20 gr. of sulphate of zinc or ipecacuanha (or in the absence of these, a teaspoonful of flour of mustard) in a tumbler of tepid water, and tickling the throat as before. If these means fail in rapidly inducing copious vomiting, inject under the skin ¼ gr. of apomorphine, or the stomach-pump must be had recourse to. Altogether as much as 6 to 18 *oz.* of the hydrated peroxide of iron may be administered. If the poison has been swallowed several hours previously, and hence may have passed the pylorus, a strong dose of castor oil or a purgative clyster may be administered, and, after its action, another clyster containing the antidote. As soon as the stomach and bowels are cleared, diuretics and sudorifics should be given in abundance. Lastly, any remaining irritation must be relieved by demulcent and soothing remedies; or if urgent, by slight general or local bleeding, which cannot be earlier practised without danger; and opium, camphor, and ether, followed by tonics, may be had recourse to to recruit the system.

Lesions. Redness and inflammation of the whole primæ viæ; and sometimes of the mouth, fauces, and œsophagus, but more usually the contrary. Sometimes also, though seldom, there is no marked appearance of inflammation in the stomach and intestines. The stomach is usually highly injected, and frequently marked with extravasations; lungs gorged with blood; mucous lining of trachea reddened; heart generally flabby, and exhibiting deep red or blackish stains, and the right cavities more or less loaded with blood; the conjunctiva is sometimes very vascular; and redness, extravasation of blood, and effusion of serum is occasionally seen in the brain. The blood is frequently, though not invariably, fluid after death, and dark coloured. Under certain circumstances, the mucous membrane of the stomach and intestines is lined with a multitude of brilliant points or grains, which have been mistaken for arsenious anhydride; but which, according to Orfila, are composed of fat and albumen. Placed on burning coals, they decrepitate on drying, and produce a species of explosion or detonation. These grains are also met with in the stomach of persons who have not been poisoned. Digested in water, the liquid obtained from them does *not* show the presence of arsenic when submitted to reagents.

Ant. In the order of their assumed efficiency: —Moist peroxide of Iron.—See under the preparations of Iron (Arsenici Antidotum, G.). Hydrated or gelatinous sesquioxide or peroxide of iron (for an adult—a tablespoonful, in water, every 8 or 10 minutes until 12 or 16 oz., or more, have been taken). Solution of dialysed iron. Gelatinous hydrate of magnesia (as the last). Calcined magnesia (taken as the first). Salad or olive oil, or almond oil, and oil or fats generally (*ad libitum*), are all highly effective in lessening, if not destroying the action of arsenious anhydride. Dr Blondlot, in a paper communicated to the Paris Academy of Sciences, has come to the conclusion that the slightest quantity of greasy matter in contact with arsenious anhydride reduces its solubility to about 1-20th of what it was before. This explains at once why, in certain judicial investigations, arsenic has been sought for in vain in the liquid contents of the stomach, when the food consisted partly of fatty substances, such as broth, milk, &c. It likewise explains how arsenious anhydride, taken in powder, may sometimes remain a long time in the stomach before it produces any deleterious effect; since, in such cases, its action is hindered by the presence of fatty matter. Jugglers often swallow arsenic with impunity, because, according to Dr Blondlot, they previously take the precaution to drink milk and eat fat bacon. Hence, in cases of poisoning by arsenic, oils and fatty substances may be administered as real antidotes, capable of suspending the action of the poison for a considerable time, until more radical means of effecting a cure can be applied. The people engaged in some of the arsenic works regard salad oil as almost a certain antidote to this poison. Albumen (white of egg), or liquids containing it (in cold water *ad libitum*). Milk, wheat flour, oatmeal gruel (with water *ad libitum*). Lime water, with milk (as the last). Chalk, with milk and water (as the last). Infusion or decoction of bark, or better, of nut-galls (as the last). Sugar or syrup (*ad libitum*). See *Treatm.* (above); also the above substances under their respective heads. Emetics are useful, but tartar emetic should be avoided, as it increases the already great depression due to the poison.

Uses, &c. Arsenious anhydride and its compounds are extensively employed in the *arts* and *medicine.* It is used by the dyer, it furnishes the artist with several of his most beautiful pigments, and the glass maker and enameller with a flux or material to whiten and decolour their wares. In *agriculture*, it is used (in solution) as an anti-smut for seed-wheat; and as an anti-vermin lotion or dipping for sheep and cattle. In small (therapeutical) doses it is a valuable remedy in intermittent fevers, chronic skin diseases (especially lepra and psoriasis), and in several nervous affections (as neuralgia, epilepsy, chorea, tetanus, &c.). It is the active ingredient of the tasteless ague-drop; of Fowler's and Pearson's solutions; and in the Tanjore pills, long celebrated in India for the cure of the bite of the cobra di capello and other venomous serpents, as well as of hydrophobia. It has been given in syphilis, chronic rheumatism, typhus, and several other diseases, with more or less advantage. Cautiously administered in phthisis, it frequently restores the appetite and strength and greatly retards, and in some cases arrests, the progress of the disease. It has been recently used to relieve toothache arising from caries. Externally, it is employed in the form of

powder, lotion, and ointment, for the cure of cancer. Plunkett's ointment, Pâte arsénicale, Davidson's Remedy for Cancer, and several other like preparations, owe their activity to arsenious anhydride. Water in which white arsenic has been steeped has become a favourite cosmetic wash with many ladies, since its assumed property of softening the skin was announced in a certain popular periodical. It is also the prime ingredient in the papier moure, a popular fly-paper. Its use, whether internal or external, is, however, attended with considerable danger in unskilful hands, and should, therefore, never be adopted but under proper advice.—*Dose*, $\frac{1}{20}$ to $\frac{1}{8}$ gr., made into pills with crumb of bread and lump sugar; or in form of Fowler's solution, 3 to 5 or 6 drops, twice or thrice daily, gradually and cautiously increased to 12 or even 15 drops. As a rule, arsenical preparations should be taken soon after a meal, and by no means on an empty stomach (*Dr A. T. Thomson*). The dose should be suspended, or greatly reduced, as soon as the conjunctiva is affected (*Hunt*); or if dryness of the mouth or throat, or irritation of the stomach or bowels, ensues. Mr Maculloch found the pills more efficacious than the solution; they act differently, and cannot be substituted for one another.

Arsenic is a favourite tonic and alterative with farriers, who often administer it very carelessly to horses, to the serious injury of these animals. It is also a favourite with grooms, who have imbibed the notion that small doses of it contribute to improve the condition of the skin. The best-informed veterinarians, however, either wholly avoid it, or use it with very great caution. "As a therapeutic agent for horses, arsenious acid can be well dispensed with. It is, however, employed by some as a tonic, in doses of from 10 to 20 gr. daily; and by others as a vermifuge. When injudiciously administered death has been the result. By those of the old school it is extolled as a caustic, and a very powerful one doubtlessly it is; but there is this disadvantage attending its use—we cannot control its action, and, oftentimes, a most extensive and painful wound is caused by it. Occasionally it is resorted to for the eradication of warts; although a better plan is to extirpate them at once with the knife. When, however, this is inadmissible, 1 part of arsenious acid, in very fine powder, may be mixed with 4 parts of lard, and a (small) portion of the compound applied, with friction, over and around the excrescence every other day, for three or four times. This will excite such a powerful sloughing action, that in about 10 days the warts will be thrown off" (*Prof. Morton*).—*Dose* (for a HORSE), 2 to 5 or 6 gr., twice or thrice daily; in farcy or glanders, 10 to 12 gr. In solution it is often employed as a wash or dipping to destroy vermin in cattle and sheep; but its use is not free from danger, particularly to the shepherds or dippers.

Gen. Commentary. The necessary length of the preceding article, owing to the great importance of the subject in its relations to toxicology and medical jurisprudence, has left us little space for further remark here. In addition to what has been said on arsenical testing, it may be useful to caution the reader of the absolute necessity of only employing reagents which are themselves *absolutely pure*; and in which the operator has, by personal examination, failed to detect the slightest trace of arsenic. Commercial sulphuric, nitric, and hydrochloric acids, potash, soda, nitre, iron, and zinc, frequently contain arsenic; from which, however, they may be freed by chemical processes; or they may be purchased in the pure state from respectable dealers in chemicals. But no assurance of the vendor should be regarded as a proof of their purity. In all judicial investigations the absence of arsenic in all the reagents and the apparatus employed must be demonstrated and sworn to. We may further add, that the results afforded by no single test can be depended on. In matters of such vast importance, the most ample confirmatory evidence must be sought.

Marsh's, Reinsch's, Lassaigne's, the sulphide, and the Reduction Tests, and their modifications, are those now generally preferred by toxicological chemists; each of which, with its confirmatory tests, are amply sufficient for the indisputable identification of arsenic.

Modern toxicologists have abandoned most of the old processes for the detection of arsenic, and have adopted one or two, which have been found more expeditious as well as more certain. These are the tests of Marsh and Reinsch, preferably the latter.

HERAPATH'S METHOD is to obtain deposits by Reinsch's Test on 4 or 5 pieces of No. 13 copper wire; each piece being about $2\frac{1}{2}$ in. long, and previously flattened and planished with a polished hammer for about one half its length. The deposit, with some of the adhering copper, scraped from one of these coated pieces, is sealed up hermetically in a tube for future production. The scrapings from three pieces of wire are separately submitted to the sublimation test in tubes bent in the form of an obtuse V capillary at one end, and about $\frac{3}{10}$ths of an inch in diameter at the other; the capillary leg being about three times as long as the larger one. The scrapings are placed in the bent part of the tube; and the flame of a small spirit lamp is so applied as to slowly drive the sublimate into the narrower portion of the tube, which is held rather higher than the other. If the deposit so obtained be mercury, it condenses in white shining globules;—if lead or bismuth, it does not rise but melts into a yellowish glass, which adheres to the copper; if tellurium, it falls as a white amorphous powder; if antimony, it does not rise at that low temperature; but if it be arsenic, it sublimes as arsenious anhydride, which condenses as minute octahedral crystals, looking, with the microscope, like very transparent grains of sand. One of these tubes containing the sublimed arsenious anhydride is then sealed up, like the first one, for future production. The capillary part of another tube containing the sublimate is then cut off, and carefully boiled in a few drops (10 to 15) of distilled water; and, when cold, 3 or 4 drops of the resulting solution is poured on a plate of white porcelain, and to this, by means of a brass rod, one drop of solution of ammoniacal sulphate of copper is added. The mixture is then carefully conducted on to a piece of white filtering-paper set on the surface of a smooth, clean, and dry chalk-stone, by which the moisture is absorbed,

and the smallest portion of Scheele's green produced by the test rendered more conspicuous. The ammonio-nitrate of silver test is then applied, in a similar manner, to 3 or 4 drops of the remaining solution; after which the pieces of paper with the spots are dried, and sealed up in separate tubes, as before, care being taken to exclude the light from that containing the yellow precipitate of arsenite of silver. A stream of sulphuretted hydrogen is then passed through the remaining tube containing the arsenical sublimate, by which the latter is converted into the yellow tersulphide—this too is sealed up. Here are now five tests—the metal, the acid, arsenite of copper, arsenite of silver, and yellow tersulphide of arsenic.

It is now well known that certain soils contain arsenic, either as arsenite of lime or sulphide of arsenic; and which, under favourable circumstances, may permeate or be absorbed by a body, after interment. In judicial investigations following disinterment it is, therefore, necessary to examine portions of the cemetery-earth taken from the grave, as well as from parts more or less distant from it. For this purpose the earth should be thoroughly dried in a water-bath, drenched with pure and concentrated hydrochloric acid, and allowed to stand for twenty-four hours. The mixture is then distilled, and the distillate tested for arsenic by Reinsch's or Marsh's test. Should the product of one distillation yield no evidence of arsenic, it should be returned to the retort, if necessary, a second or even a third time, and the distillation repeated.

The practice of employing an alkaline solution of white arsenic as an anti-smut steep for wheat has lately arrested the attention of chemists. M. Audouard states that he has detected traces of arsenic in the crops raised from seed-wheat thus treated. But that which appears to be likely to prove much more dangerous is the introduction of arsenic into crops by the employment of crude superphosphate of lime as manure—a substance often rich in this poison. Dr Edmund Davy positively states that arsenic, as it exists in artificial manures, is taken up by plants growing where those manures have been applied! He found cabbages and turnips taken from fields manured with superphosphate give unmistakable evidence of being 'arseniated.' These facts have some important bearings; for though the quantity of arsenic which occurs in such manures is not large when compared with their other constituents, and the proportion of that substance which is thus added to the soil must be necessarily small, still plants during their growth, as in the case of the alkaline and earthy salts, take up a considerable quantity of this substance. Further, as arsenic is well known to accumulate in soils, though not an accumulative poison in the animal system, the effects after some time will probably be, that vegetables raised on those continuously so manured will ultimately be found to contain such a proportion of arsenic as will exercise an injurious effect on the health of man and animals. The statement of M. Audouard has been disputed by M. Girardin, because he failed to detect arsenic in corn under the circumstances; and it is also denied by Dr A. S. Taylor, and others; but our own (*Tuson*) experiments, very carefully performed, confirm the assertions of both Audouard and Davy.

Dr Lois has found arsenic, often in large quantities, in ordinary brass and brass utensils; and we have ourselves (*Tuson*) repeatedly found arsenic in the Britannia-metal, German-silver, and other cheap white alloys at present in such general use.

The preceding facts are recommended to the careful attention of medical jurists.

By Act of Parliament (14 Vict., c. xiii, 1851) it is provided—1. That every vendor of arsenic shall, before the delivery of the same to the customer, enter in a book or books, kept for the purpose, the date of sale, name, and residence of the purchaser, in full, his or her condition or occupation, the quantity so sold, and the purpose or purposes for which it is required, in a form set forth in the schedule to the Act; which form or schedule shall be signed by the vendor, and by the said purchaser, unless he be unable to write, when such fact shall be recorded in the said schedule by the vendor; and this schedule, when a witness is required to the sale, shall also bear his signature, together with his place of abode:—2. Arsenic is not to be sold to a stranger, unless in the presence of a witness acquainted with both vendor and purchaser:—3. No person to sell arsenic unless it be previously mixed with at least 1 *oz.* of soot or ½ *oz.* of indigo to the pound; unless such admixture would be injurious to the object for which it is intended, when not less than 10 *lbs.* is to be sold at any one time:—4. Penalty for evading the Act, either as vendor, purchaser, or witness, £20:—5. Act not to extend to arsenic used in compounding prescriptions nor to the wholesale trade:—6. The word 'arsenic' to include 'arsenious anhydride,' and the arsenites, and arsenic acid and the arseniates, and all other colourless poisonous preparations of arsenic. See ARSENIC, ARSENIC ACID, LOTIONS, PILLS, SHEEP-DIPPING, SOAPS, SOLUTIONS, WHEAT-STEEPS, IRON, POTASSA, SODA, and other Bases, &c., &c. (also *below*).

Self-detect′ing Arsenious Anhydride. *Prep.* (*Dr Cattell*).—1. Ordinary white arsenic to which is added a small quantity of a mixture of dry calomel and quick-lime; or of dried sulphate of iron and powdered gall-nuts. The product is white, but immediately turns black when mixed with liquids:—2. As the last, but adding a mixture of thoroughly dried sulphate of iron and ferrocyanide of potassium. Strikes a blue:—3. As last, but using dried phosphate of sodium and dried sulphate of iron. Strikes a green. Proposed as a method of preventing arsenic being used as a poison.

ARSENICAL PIGMENTS, EFFECTS OF. The composition of those substances which are compounds of copper with arsenious, very frequently combined with acetic acid, will be found under GREEN PIGMENTS, under their respective commercial names of SCHEELE'S GREEN, MINERAL GREEN, EMERALD GREEN, and SCHWEINFURT GREEN. The purity of tint and durability of these arsenical salts have, not unnaturally, caused them to be employed in many branches of industry, the products of which are everywhere around us, and as the colouring material of these,

they are placed in conditions very favourable to their being taken into the stomach or lungs. This will be apparent when we name a few of the materials in which they are employed:—wafers, candles, wall-papers, window curtains, confectionery.

A curious illustration of the risks attending their use may be cited from the 'Medical Times and Gazette' of April, 1854, which states that some loaves found to contain arsenic were discovered on inquiry to have got the dangerous intruder from having been allowed to stand on shelves freshly painted a bright green colour. Arsenical-coloured wafers may be pronounced free from danger so long as they are kept out of the reach of children; and although the arsenical vapours given off by burning a green wax taper would not be sufficient to induce toxic results, the fact of the extreme sensibility of some people to the action of this poison when taken in by the lungs renders the use of these tapers a very objectionable one, particularly if they are generally employed in a household. The burning of wax candles coloured with arsenical green is, of course, still more strongly to be condemned, because from its superior mass, when compared with the taper, the candle gives off a greater amount of the poisonous fumes. An arsenical taper weighing 17·69 grains was found upon analysis by Mr Bolas, late of Charing Cross Hospital, to contain 0·276 grains of arsenious acid. "A Christmas tree," says Mr Blyth, "brilliantly illuminated with Christmas candles, may be taken as an extreme instance of the danger likely to arise from this source." That the employment of arsenical green in the manufacture of sweetmeats was not abandoned in 1873 may be evidenced from a circumstance quoted by Mr Blyth in his work on 'Hygiene.' "During the Christmas of 1873 a large cake in which was embedded a green card labelled 'for the bairnies,' was seized in a baker's shop at Greenock. The card was coated with sugar, and on being submitted to analysis, was found to contain 7·04 grains of arsenious acid."

A curious case, illustrating the effect of arsenical wall-papers, is furnished by Dr Dalzell, of Malvern. He was attending a lady ill with scarlet fever, and during the attack her husband occupied a small bedroom. The first night he slept in it his slumbers were most unrefreshing and disturbed by horrible dreams, and on rising in the morning he felt languid and weak, had lost his appetite, and had a dull headache. Towards the evening these unpleasant symptoms had nearld vanished. On the second night (when he occupiey the same dormitory) and on the day following the same disagreeable symptoms returned. He then changed his bedroom, and forthwith they troubled him no more. A servant, who next occupied the chamber, was affected as her master had been. Dr Dalzell suspecting the wall-paper as the cause, examined it, and found it to contain a large quantity of arsenic.

Some little time since Mr Bolas examined a sample of wall-paper containing 27·53 grains of arsenious acid in the square foot, and in this case the pigment was so loosely fixed that the slightest friction was sufficient to detach a portion and diffuse it through the air. Nor is this surprising when we consider how slightly the arsenical colour is attached to the surface of the paper, as well as how easily it may become liberated from it by the desiccation of the air of the room when heated by a fire. This may be exemplified by drawing the sleeve of a black or dark-coloured coat over an arsenical wall-paper, and observing the green deposit that is left on the garment.

After this we shall be prepared for the following statement: "Hamberg drew, by means of aspirators, the air of a room, the walls of which were papered with a very old green paper, through various tubes containing cotton wool and silver nitrate. On examination scarcely any solid particles could be discovered. The cotton-wool was fused with sodium nitrate and carbonate, and gave a little ferric oxide and a trace of arsenic, but the solution of nitrate of silver gave decided evidence of arsenic, as well as of sulphide of silver" ('Phar. Jour.').

Not many years since Professor Fleck showed that the arsenious acid in the Schweinfurt green when in contact with moist organic substances, and especially starch-sizing, forms arseniuretted hydrogen, which diffuses in the room, and which is no doubt the cause of some of the cases of arsenical poisoning from green papers. So that a contrary condition to a dry atmosphere, viz. a moist or damp one, may also lead to results nearly, if not quite, as objectionable, when rooms are papered with arsenical papers. We have Mr Blyth's word for the assertion that the most dangerous of the arsenical papers, viz. those covered with a thick, unvarnished, loosely coherent layer of Scheele's green, are most frequently to be met with in our nurseries, where the beds are placed next the wall, and where the attrition of the bedclothes frequently removes portions of the poisonous colouring matter. The fine cupro-arsenical dust which thus becomes diffused through the room now and then produces in children symptoms resembling those of violent catarrh. Some of the wall-papers of these nurseries have been found to yield 18 grains of arsenious acid in a square foot. It would appear that the use of arsenical pigments is by no means restricted to green wall-papers. Very recently an analytical chemist examined a great number of samples of wall-papers of different colours, and was surprised to find arsenic in most of them. Dr Tuson examined the pigment which he could disengage without much difficulty from a very small piece of green muslin window curtain, and found it yield a large quantity of arsenic. In Paris alone there are more than 15,000 people who earn their living by making artificial flowers, a quarter at least of these workers being engaged in that branch of the manufacture in which Schweinfurt green is used. From the instances already adduced of the ill effects caused, although in a mild degree, by occasional and accidental exposure to arsenical pigments, we shall be prepared to learn that the danger and the damage to health is very much more intensified when, as in the case of these poor artisans, the workman is constantly handling the deadly material, and incessantly inhaling an atmosphere laden with its particles. Dr Vernois has published a most interesting description, which we subjoin, of the artificial flower-maker at work.

He says:—"These greens are formed either from arsenite of copper alone, or mixed in variable proportions with acetate of copper (English green). Arsenical greens are employed to colour different herbs, to tint the fabric destined to prepare the leaves of artificial flowers, as they are painted directly on the leaves or petals of flowers worked on cloths of various textures. For these various purposes they buy the Schweinfurt or the English green (vert anglaise), either in powder or in aqueous solution, and add to it, according to the effect desired, a certain quantity of Flanders glue, starch, gum, honey, or turpentine. Sometimes it is applied in the dry state, in order to sprinkle it over the things already coloured by the arsenical green. They frequently also, in order to modify the colour, mix with it a certain quantity of chromate of lead or picric acid.

The preparation of herbs is carried on as follows:—The workman plunges into a shallow vessel, containing a sufficiently liquid solution of Schweinfurt green, one or several stalks of natural plants, perfectly dried, and agitates them quickly, seizing them by their roots with a pair of forceps. This operation, which is termed 'steeping,' stains the fingers, the arms, the person, and the clothes of the workman, and the surrounding objects are covered with traces of this kind of paint. The plants thus prepared are hung on a line, and there allowed to dry for thirty-four or forty-eight hours. At the end of that time all the stalks are gathered and formed into bundles, which are used finally for bouquets. Often enough, to satisfy some freak of fashion, they are sprinkled with powdered arsenite of copper. This is the powdering. The bouquet work constitutes one of the principal dangers; for the colouring matter, not having been fixed by any mordant, detaches itself in the form of a fine dust, which penetrates the skin of the hands, and which the workman breathes constantly. This danger is still more increased when he handles bouquets covered with arsenical powder. At other times, however, in the manufacture of the plants, the Schweinfurt green is diluted with a sufficient quantity of turpentine. In this way the colour takes a smooth appearance, not altered by contact with water, and does not escape immediately in the form of powder by gentle handling; but when it is thoroughly dry it falls to the ground in little flakes, and may again rise in the air with ordinary dust. Thus the danger is modified, a little retarded, but always exists. There are then in this speciality of the florist the operations of steeping, drying, powdering, and arranging the flowers for bouquets, which in their details place the workman or the purchaser under the more or less direct and more or less active influence of arsenical salt. This particular industry is exercised under conditions which render it still more injurious; for it is freely practised by a number of poor workpeople, by households living in one or two rooms, ill-ventilated, ill-lighted, and which they never sweep, and of which the floor like the furniture, and like the clothing of the workpeople, is continually impregnated by pigment and covered with arsenical dust. The preparers of the cloth destined for the manufacture of the artificial leaves by the aid of arsenical greens, comprehend the portion of the work most exposed to deleterious action. They use arsenite of copper alone, mixed principally with starch, and in rare instances associated with acetate of copper in variable proportions. Some use *eublée*, a mixture of picric acid and of greenish indigo, in which they steep their stuffs. Other manufacturers use fabrics prepared with hot solutions by ordinary dyers. According to the hue which the Schweinfurt dyer wishes to obtain, the workman commences by giving the stuff a yellow shade, by plunging it into a solution of picric acid and pure alcohol. He squeezes it between his fingers, in order to completely impregnate it, and dries it. It is this preliminary operation which stains the workman's fingers yellow. Frequently the latter mixes picric acid by grinding it with the Schweinfurt green, and applies this paste immediately to the fabric. The paste is prepared by kneading the Schweinfurt green, already treated with water, with a solution of starch thick enough, yet sufficiently liquid, to be easily spread on the cloth. During this working up the paste the fingers, arms, and hands of the workman are covered with arsenical solution. This being ready, the workman lays out his stuff, distributes the paste over it, then beats it between his hands, in order to make the colouring matter thoroughly penetrate the cloth. The longer it is beaten the better is the quality of the article. During this operation the skin of the hands and arms is completely impregnated with the solution. Sometimes the cloth, having been touched here and there with arsenical paste, is attached to a hook in the wall, and twisted different ways—wrung, as it were. In this way a very uniform colouring is obtained. This process is as bad for the workman as the former. Lastly, a process which is generally practised consists in placing the fabric, stained or not with picric acid, on a wooden table, and distributing on both sides the arsenical preparation with a brush, and then beating the stuff with a thick rubber. In this way the hands and arms of the workman are much less exposed to the paste than in the preceding processes. After the brushing and beating of the fabric comes the drying, to which operation attention must next be directed. Once impregnated with the green colour by whatever process, the pieces in squares of about 1 metre 50 cent. are hung on wooden frames, furnished with teeth, on which the borders of the cloth are transfixed. During this simple operation the workmen stain themselves much. When the stuffs are detached from the squares they are folded, and from every crease falls a fine dust, which may then be carried into the mucous membranes. The workmen then are liable to all the accidents of the manufacturers of flowers, especially in the operations of kneading the paste, or during the beating, brushing, drying, and folding of the cloths. From the hands of the workman the fabrics are very often immediately consigned to the manufacturers of artificial flowers, who press them, figure them (that is to say, make the nerves), arm them with a wire, and mount them with flowers. It may be at once understood how much all the manipulations I have just mentioned are liable to develop the arsenical dust. The paste has not been fixed on the stuffs by any mordant; the starch with

which it is mixed has given it a very brittle consistence, and has predisposed it to be easily detached from the cloth.

The stamping is effected by putting a certain number of folded pieces one above the other, and submitting them to the pressure of a stamping instrument. Repeated blows of this instrument detach the paste in scales, and cover with dust the fingers and person of the workman. A series of small packets are taken from the stamping press, which contain, strongly pressed together, from twelve to twenty-four leaves. They are passed on to another workman, who is charged with the folding. This operation is performed by holding the little bundle of leaves between the thumb and index finger of the left hand. The thumb of the right hand presses the edges quickly and sharply so as to separate the leaves from one another, as you separate the leaves of a book recently bound. During this process still more dust escapes. Then comes the figuring, which by reason of successive blows applied to each leaf covers the body of the operator with the same pulverulent material. Fixing a wire to the leaves at their lowest part by the aid of gum follows that operation.

Then the leaves are arranged together in dozens, and passed to the bouquet manufacturers, who mount them. From thence they go to the milliners, who adapt them to different articles of dress, and sell them to the public. Through all this series of transformations there are the same manipulations, the same production of dust, the same action on the skin and mucous membrane, only in a decreasing degree, from the first preparer to the milliner. There is, however, a process of preparing the cloth which diminishes notably the severity and frequency of the evils of the Schweinfurt green. It is that which immediately after the drying of the stuffs submits them at once to the 'calendrage.' This operation causes the arsenical paste to penetrate mechanically into the fibres of the stuff, and gives it a smooth and glazed aspect, which only permits imperfectly the production of the arsenical dust. This process renders the successive workings of the cloth less injurious, but it would be an error to consider it as inoffensive. During the action of the press, and especially during the separating and the fixing of the flowers, a notable quantity of the toxic dust is still produced. However well prepared the fabrics may be, it requires only to be torn in order to detach the coating in the form of a palpable powder.

It is only necessary to add that the waxing of the leaves, after they have been separated and figured, and before putting them into bouquets, constitutes a protecting envelope against the effects of the powdered coating for workmen who then handle them, as well as for women who wear them; but this film of wax is only applied, comparatively speaking, to a small number of leaves, for it alters the green and vivacity of its colour.

In the preparing of the stuffs in the process of drying, Dr Vernois says:—A new condition and serious results appear. The multiplicity of sharp points fixed in the wooden squares inevitably pricks and scratches the skin of the workmen. Inoculation with the arsenical salt immediately takes place, as if it had been practised experimentally. The skin is irritated and inflames, a vesicle first, then a large pustule covers the orifice of the prick, and undergoes all the stages of inflammation, which produces suppuration and often gangrene, below which a deep and painful ulceration is developed—all the more tedious to heal as the inoculation is renewed from day to day.

The action of picric acid mixed with the paste only augments and aggravates the irritation of the wounds. If the ulcerations are numerous the workmen may absorb the arsenious acid and be liable to serious results. I have seen a certain number of workmen with glandular enlargements under the armpits, and the hands in such a state that they were obliged to come to the hospital, where they were only cured after one or several months of treatment. The aspect of the hand, and especially of the palmar aspect, was then characteristic of the greenish-yellow tint of the whole skin. To the greenish crust under the nails was nearly always added a yellow colour of the nails, produced by the repeated contact with picric acid.

When we add a generally diffused erythema, then a series of black points, or of inflamed pustules, and sometimes a whitlow, we shall have a faithful representation of the evils which most frequently present themselves in the preparers of stuffs for artificial flowers tinted with Schweinfurt green.

Amongst the endeavours to counteract the evils entailed upon the workers in this branch of industry may be mentioned the attempt to substitute chrome for Schweinfurt green, as the less poisonous of the two substances, and the ingenious process of M. Bérard-Zenzilin, which consists in directly incorporating the arsenical colouring matter with a specially prepared collodion.

Arsenic and Arsenical Compounds in Medicine.—The following preparations are officinal:

LIQUOR ARSENICALIS. Arsenical solution. *Syn.* LIQUOR POTASSÆ ARSENITIS. Fowler's solution. Arsenious acid in powder, carbonate of potassium, of each 87 gr.; compound tincture of lavender, 5 fl. dr.; distilled water, a sufficiency. Boil the acid and carbonate with half a pint of water until they are dissolved. To the cold liquor add the tincture, and, lastly, as much water as will make up a pint. A reddish liquid, alkaline to test-paper, and having the odour of lavender. When acidulated with hydrochloric acid it gives, with sulphuretted hydrogen, a yellow precipitate, lightest when the arsenical solution has been previously diluted. One fl. oz. boiled for five minutes with 10 gr. of bicarbonate of sodium, and then diluted with 6 fl. oz. of water to which a little mucilage of starch has been added, does not give with the volumetric solution of iodine a permanent blue colour until 875 gr. measures have been added, representing 1% of arsenious acid, or rather more than 4 gr. ($4\frac{1}{3}$) in 1 fl. oz. (*Garrod*).—*Dose,* 2 min. to 5 min., or occasionally to 10 min.

LIQUOR ARSENICI HYDROCHLORICUS. Hydrochloric solution of arsenic. Arsenious acid in powder, 87 gr.; hydrochloric acid, 2 fl. dr.; water, a sufficiency. Boil the hydrochloric acid and arsenic in 4 oz. of the water, and add water

till the bulk is a pint. A colourless liquid, with an acid reaction. Sp. gr. 1·01.—*Dose*, 2 min. to 8 min.

SODII ARSENIAS. Arseniate of sodium. $Na_2HAs_2O_4,12H_2O$; and $Na_2HAsO_4,7H_2O$.

Prep. Made by finely powdering and intimately mixing together 10 oz. of arsenious acid, 8½ oz. of nitrate of sodium, and 5½ oz. of dried carbonate of sodium; afterwards putting the mixture into a large clay crucible covered with a lid, and exposing it to a full red heat till effervescence has ceased and complete fusion has taken place. While still warm it is dissolved in boiling water, and then set aside to crystallise. In this process the arsenious acid gets oxidised at the expense of the nitric acid, and combines with the sodium; carbonic acid and nitric oxide escape.

Off. Prep. Liquor sodii arseniatis, solution of arseniate of sodium. Arseniate of sodium, rendered anhydrous by heat not exceeding 300° F. (148·9° C.), 9 gr.; distilled water, 2 fl. oz.—strength 1%.—*Dose* of the crystallised salt, $\frac{1}{16}$ gr. to $\frac{1}{8}$ gr. of solution of arseniate of sodium, 5 min. to 10 min. or more.

LIQUOR ARSENII ET HYDRARGYRI IODIDI. Solution of iodide of arsenic and mercury; Dowman's solution.

Prep. Iodide of arsenic and red iodide of mercury, each 45 grains; distilled water, a sufficiency. Triturate the iodides with about an ounce and a half of distilled water until nearly all is dissolved. Pass through a filter and wash the latter with sufficient water to produce 10 fl. oz. of solution.

Uses. Chiefly in obstinate skin affections, and especially those depending on syphilis. Freely diluted, it has been used as a lotion in similar cases.

Dose. 10 min. to ½ fl. dr., diluted and given with similar precautions to those required in the administration of preparations of arsenic.

FERRI ARSENIATE. See under IRON.

ARSENII IODIDUM.

Prep. By the direct union of iodine and metallic arsenic, or by evaporating to dryness an aqueous mixture of arsenious and hydriodic acids. Occasionally employed in the treatment of chronic cutaneous affections, or in psoriasis and chronic eczema.—*Dose*, $\frac{1}{30}$ gr.

In recent years the use of arsenic as a prophylactic or remedy in intermittent fever has become more general than formerly, and its value in the treatment of malarial disorders is better understood and recognised.

Some of the railways of Southern Italy were almost paralysed by these diseases, which were so prevalent among the *employés* as to necessitate the services of extra shifts of men to take the places of those unfit for duty; and this, together with the expense of quinine and sick pay, caused these lines to be worked at a great loss; experiments were conducted on the *employés* with arsenic, regular arsenic parades were held and the drug administered in small doses to each man in the form of gelatine discs. It was found that among those who were thus treated the number of cases was very greatly diminished, and especially their severity, and the results were altogether most encouraging.

The use of arsenic in malarial disease requires discrimination. Fowler's solution may be given three times a day in doses of 3 to 5 or even 10 drops if the patient be under supervision, and it would appear that the best results are obtained when it is given for three or four days, and then discontinued for the same time; its use should not be continued long after the attacks have ceased.

As a prophylactic small doses 2 to 3 drops of Fowler's solution two or three times a day after meals for a few days previous to exposure to a malarious climate is probably useful, but the amount of the dose and the protection afforded seem to vary considerably in different individuals.

Arsenic appears to be more useful than quinine in chronic cases, especially when the attacks are ill-defined and irregular, and a mixture, containing 5 drops of Fowler's solution in 5 grains of quinine to the dose, will often be found more effectual in combating an acute case than large doses of quinine alone, which should not be given unless the state of the patient is such as to call for very active interference.

ARSENIC AS COSMETIC. The defence set up in a recent '*cause celèbre*' (the Maybrick trial), in which a woman was convicted of causing the death of her husband by the administration of arsenic, has drawn public attention to the uses of arsenic for the purpose of improving the bodily appearance; and it may be well here to state briefly and generally a few facts bearing upon this subject. In the Maybrick case, counsel for the defence called expert evidence to prove that the use of arsenical washes for improving the complexion, was by no means uncommon amongst women, and especially in Germany; the defence being in this case that the arsenic found in the house in which her husband died had been procured by Mrs. Maybrick for this purpose. The question of how far these arsenical washes are used is one which is somewhat difficult to decide, involving as it would a very careful analysis of all the countless preparations used for this purpose. This much is certain, that a very large number of them do *not* contain arsenic. It would further seem improbable that arsenical lotions should be much employed, because the continual use of the drug even in minute doses would be liable to produce characteristic symptoms, and if persisted in would defeat the object of the user. The idea of using arsenic externally for such a purpose has probably arisen from the known value of the drug in many obstinate skin diseases, when properly administered internally. A correspondent of the 'British Medical Journal' at the time of the trial said, "I have seen the hands and arms of sheep-washers inflamed from the same cause (continual immersion in arsenical 'dipping' fluids"). Some authors state that the prolonged use of arsenic in small doses produces a very unsightly brown staining of the skin. The fly-papers from which Mrs. Maybrick is said to have obtained some of the arsenic with which she poisoned her husband were prepared with arseniate of soda, and this mode of preparation was probably suggested to the makers by the Poudre aux mouches or Fleigengift an almost black powder obtained by exposing metallic arsenic to the air, and which used

to be employed on the Continent for the destruction of insects.

The internal use of arsenic for improving the complexion and the supposed large consumption of it by the Styrian peasantry has already been referred to, and though these stories have possibly been greatly exaggerated, there is very little doubt but that arsenic properly administered exerts a profound influence upon the metabolism of the body, although the nature of this influence is still not understood. It would appear that, in spite of many statements to the contrary, the internal use of arsenic does tend to produce plumpness and sleekness of the skin. The original account of the arsenic eating by the peasantry of Styria by Dr Von Tschudi appeared in 'Le Journal de Chimie Médicale,' 1854.

AR'SENIDE. *Syn.* ARSEN'IURET; ARSENIURE'TUM (-i-ū-), L.; ARSÉNIURE, Fr. A combination of arsenicum with a metal (including hydrogen), in definite proportion.

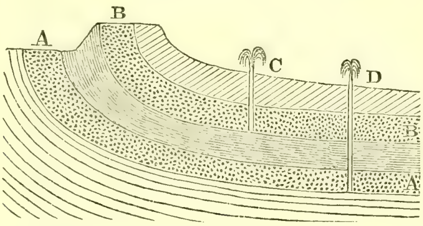
AR'SENITE (-nīte). *Syn.* AR'SENIS, L.; ARSENITE, Fr.; ARSENIGSÄURE SALZ, Ger. A salt of arsenious acid.

ART. [Eng., Fr.] *Syn.* ARS (gen., ar'tis; pl., ar'tes), L.; τέχνη, tech'ne, Gr.; KUNST, Ger. Primarily, strength, power, and hence also mental strength, skill; the application of knowledge or power to effect a desired purpose; the power or ability of doing something not taught by nature or instinct; practical skill guided by rules. SCIENCE is knowledge—ART, practical skill in applying this knowledge. ART is applied science; whilst SCIENCE is knowledge obtained by observation, experience, and ratiocination. This distinction is nowhere more fully seen than within the domain of chemistry, where knowledge deduction, great power generalisation, and great expertness are necessary elements of success. Art has filled the world with luxuries, conveniences, and comforts; and art—the ARTS—useful or fine—are the safest and surest civilisers of our race. See SCIENCE.

ARTEMISIA. The genus of plants which includes the wormwood, mugwort, southernwood, &c.; so named from *Artemis*, the goddess Diana.

ARTERIES. In *anatomy*, the vessels which carry the blood *from* the heart. They are distinguished from veins by the possession of a large amount of elastic tissue in their coats; by their being empty after death; by their spurting with each beat of the heart when cut during life. In order to stop bleeding from an artery the pressure must be applied on the side of the injury nearest the heart. The elastic fibres in the walls of the arteries when cut retract and curl up, thus blocking the vessel in some degree and affording a number of points which materially assist the coagulation of the blood.

ARTESIAN WELL. A cylindrical perforation bored vertically down through one or more strata of the earth till it reaches a porous bed of gravel containing water, this fluid being placed under such incumbent pressure that it rises up the perforation either to the surface, or to a convenient height for the operation of a pump. When they rise to the surface, these wells are called spouting or flowing. The name of these wells is taken from Artois, a province in the Departement du Pays de Calais, where their use was revived. They have been in use for a long time in Italy and in the East. The accompanying drawing represents the manner in which rain may be supposed to distribute itself when it falls upon a portion of the surface of our globe.



The figure represents a geological section, showing the succession of the different strata, and of these, two beds, A, B, more porous, and consequently more absorbent than the rocks among which they are interposed. The condensed dews and rains falling upon the distant hills pass rapidly by the outcrops of the strata to the lower levels, until the entire mass becomes thoroughly saturated with water. Supposing two such beds as are represented in the section to exist, fully charged with water, it is evident that if we bored down into them through the rocks as represented at C, D, the water would rise through those wells or borings, and spring out in the form of a jet to such a height above the surface as is due to the heighth of the hills from which the water has been obtained. The fountain derived from B would necessarily flow as much higher as that derived from the bed A, as is the height of B above A.

For particulars as to the modes of constructing artesian wells, the reader is referred to 'Traité sur les Puits Artesiens,' by M. Garnier, and to 'Considérations géologiques et physiques sur la théorie des puits forcés, ou fontaines Artésiennes,' by M. le Vicomte Hericart de Thury, and to 'Rudimentary Treatise on Well-digging, Boring, &c.,' by J. G. Swindell, and also to Ure's 'Dictionary of Arts, Manufactures, and Mines,' edited by Mr Robert Hunt. See WELL-SINKING.

ARTHANI'TINE (-tĭn). [Eng., Fr.] *Syn.* ARTANI'TINE; ARTHANITI'NA, L. A peculiar substance first obtained by M. Saladin, by the action of alcohol on the tuberous stems of the herb *arthani'ta*, or sow-bread. It is acrid, colourless, and crystalline, and imparts its acridity to the plant.

AR'TICHOKE. *Syn.* CIN'ARA, CYN'ARA; SCOL'YMUS, L.; ARTICHAUT, Fr.; ARTISCHOCKE, Ger.; CARCIOFI, Ital. The *Cynara scolymus*, Linn. A thistle-like perennial plant of the Nat. Ord. COMPOSITÆ (DC.).—*Hab.* Southern Europe; but now extensively cultivated in our gardens, for its 'bottom,' or the sweet fleshy receptacle of its flowers, which is eaten as a pot-herb. These are soaked in brisk boiling in water, stalk-ends uppermost, until tender; and take ½ to 1 hour according to their age. Sometimes they are preserved in brine (PICKLED ARTICHOKES); and also after depriving them of the 'choke' and spiny hairs and blanching them by immersion in boiling water, by drying in the sun (DRIED ARTICHOKES; CULS

D'ARTICHAUT, Fr.), by which they retain their flavour for some time. Infusion of the flowers, used with rennet.

As an esculent the artichoke resembles asparagus in its general properties; but it is said to be more nutritious, and even more diuretic.

Artichokes, Jeru'salem. The *Helianthus tuberosus*, Linn., a perennial plant of the sunflower family, and quite distinct from the preceding. Originally introduced from the Northern United States. The Jerusalem Artichoke has been cultivated in England as an article of food since early in the 17th century. The tuber does not contain starch, hence it is not floury when boiled, like the potato. The appellation 'Jerusalem' is believed to be a corruption of the Italian word *girasole*—'a sunflower,' to which botanical family the plant belongs. It is cultivated in England for culinary purposes. Roots (tubers) resemble the artichoke in flavour; but are considered far from wholesome, being apt to produce flatulence and dyspepsia. They are diuretic, and impart the odour of turpentine to the urine. They are cooked by boiling (15 to 25 minutes, according to size), or frying; in the former case served with melted butter. They are also served mashed, like turnips.

Composition of the Jerusalem artichoke from an analysis by Payen, Poisot, and Fevry:

Nitrogenous matter	3·1
Sugar	14·7
Inulin	1·9
Pectic acid	0·9
Pectin	0·4
Cellulose	1·5
Fatty matter	0·2
Mineral matter	1·3
Water	76·0
	100·0

From the above it will be seen that this esculent contains practically no nitrogen.

ARTIFICIAL FOODS. See FOODS.

ARTISANS AND LABOURERS DWELLINGS IMPROVEMENT ACT, 1875 (38 and 39 Vict. c. 36, amended by 42 and 43 Vict. c. 63, and by 45 and 46 Vict. c. 54).

This Act was passed to facilitate the removal and reconstruction of unhealthy dwellings in the more densely populated parts of large urban sanitary districts. Under its power the buildings in any unhealthy area may be demolished in order to make room for new streets and improved dwellings, which under special circumstances may be constructed by the Local Authority itself (section 9). The Act is not applicable to urban sanitary districts with a population under 25,000, nor to rural sanitary districts (section 2).

For the purposes of the Act a medical officer of health shall report, to the Local Authority, on any area the condition of which appears to him to require it, or if two or more justices or twelve or more ratepayers of the district complain to him of the unhealthiness of the area, it shall be his duty to inspect and report upon it.

If the Local Authority do not consider it desirable, on receipt of this report, to adopt its suggestions, it must send a copy of it, with reasons for disapproval. to the *confirming authority* (the 'confirming authority' for the City of London or metropolis is the Secretary of State; that for the Sanitary Authorities the Local Government Board). If the Local Authority approve of the suggestions made by the medical officer of health it must prepare a scheme to be submitted to the 'confirming authority' for their approval. If the Local Authority is satisfied, "of the sufficiency of its resources," it shall pass a resolution to the effect that such area is an unhealthy area and that improvements are required. If the Local Authority fail to carry out a scheme which has been approved, the 'confirming authority' may step in and act. According to the Amending Act, 1879, the buildings to be erected, instead of the unhealthy ones demolished, may be in some place other than that within the area comprised in the improvement scheme. The Local Authority is also authorised to purchase land, or use any it possesses for the erection of such buildings. The Amendment Act of 1882 contains a most important provision to the effect that, if in any place to which 45 and 46 Vict., c. 54 applies, the medical officer of health finds that any building, though not itself unfit for habitation, causes any of the following disadvantages:

1. Conduces to make other building unfit for habitation (*e.g.* by stopping ventilation, &c.), or
2. Prevents the defects in other buildings being remedied, then proceedings may be commenced for the demolition of this building.

ARUM MACULATUM (CUCKOO PINT OR WAKE-ROBIN). Nat. Ord. ARACEÆ. The leaves and roots of most of the plant belonging to this order contain an acrid juice with a pungent, biting taste, in some cases very poisonous. The acrid principle can, however, be very readily dissipated by heat, and the roots then become valuable as food. Formerly the fresh root was used in medicine as a diuretic and expectorant; the juice acts as an irritant to the skin. The roots of *Arum maculatum* were once largely used in this country for the production of so-called Portland sago or arrowroot. 1 peck of the tubers yields about 3 lbs. of starch. The preparation of this starch is now given up, as it is cheaper to make it from grain or potatoes.

The West Indian Yam is the root of *Colocasia esculenta,* one of the same family.

ASARABAC'CA (ăs-ă-). *Syn.* AS'ARUM, A. EUROPÆ'UM, Linn., NAR'DUS MONTA'NA*, &c., L.; ASARET, A. D'EUROPE, CABARET, AZARUM C., NARD SAUVAGE, OREILLE D'HOMME, &c., Fr.; HAZELWURTZEL, Ger. The ἄσαρον of Dioscorides, a small, round, hard, stemless, hardy herbaceous plant, bearing chocolate-coloured flowers; and of the Nat. Ord. ARISTOLOCHIÆ (DC.). It grows freely in Central France, and is found in woods and shady places in Lancashire, Westmoreland, and other parts of England.—*Hab.* Europe, between 37° and 60° latitude.—Root and rhizome (AS'ARI RA'DIX) has a pepper-like odour and an acrid taste:—Leaves (A. FO'LIA) less odorous, though bitter-tasted, acrid, and aromatic; formerly officinal in the pharmacopœias:—Whole plant (ASARABACCA of the shops) nauseant, emetic, and purgative. Before the introduction of ipecacuanha it was the common emetic (6 to 9 of the green leaves in whey); but, owing to the violence of its action, it has long fallen into disuse. Its

common name in France (CABARET, or public-house plant) is said to have arisen from its frequent employment to relieve the stomach of those who had drunk too hard. It is now almost solely used as a sternutatory or errhine, and is probably one of the best.

According to Gräger (Gobel and Kemze, 'Pharm. Waarenk,' 1830–1), asarabacca contains three volatile, oily principles, which may be obtained by distillation with water:—VOLATILE OIL (o'leum as'ari):—AS'ARITE, an odourless, tasteless, and crystalline solid; fusible and volatilisable, yielding white and very irritating fumes:—AS'ARUM CAM'PHOR, differing chiefly from the last in being precipitated, by water, from its alcoholic solution in cubes or six-sided prisms, instead of delicate flexible needles. Also a brownish, bitter, crystallisable principle (AS'ARINE, AS'ARUM-BIT'TER), which is soluble in alcohol.

Uses, Dose, &c. Dried leaves, 20 to 30 gr., or root, 10 to 12 gr.; as a purge or emetic. As an errhine—leaves, 3 to 5 gr.; root, 1 to 3 gr.; in powder, snuffed up the nose every day, or every other day, at bedtime. It excites irritation and a copious watery discharge, more or less muculent, which frequently continues to flow for several days, and occasionally proves highly useful in certain affections of the brain, eyes, mouth, nose, ear, and throat, on the principle of counter-irritation. It has been found "particularly serviceable in cephalalgia (headache), obstinate headache, chronic ophthalmia (inflammation of the eyes), and some other lethargic affections" (*Dr A. T. Thomson*). In dimness of sight (especially that arising from fatigue or congestion), deafness, and slight paralytic affections of the mouth, tongue, lips, or eyelids, not of a serious organic character, and particularly in chronic earache, it also sometimes affords relief after other remedies have failed. It constitutes the basis of several CEPHALIC SNUFFS, ASARABACCA SNUFF, BARON MCKINSEY'S MEDICINAL POWDER (or SNUFF), and several other like nostrums, which are much extolled by their vendors, and sold at marvellously high prices. See PATENT MEDICINES, POWDERS, SNUFFS, &c. (also *below*).

AS'ARIN (-rĭn). $C_{20}H_{26}O_5$. *Syn.* ASARONE. A species of stearopten, discovered by Görtz, in asarabacca. It has an aromatic taste and an odour resembling camphor, and is said to be emetic. It is probably a mixture of asarum camphor and some partially oxidised volatile oil. (See *above.*)

As'arine (of Gräger). *Syn.* ASARI'NA, L. The crystallisable bitter principle of asarabacca, noticed above. It is said to greatly resemble cytisine.

AS'ARITE (-rīte). See ASARABACCA.

ASARUM CANADENSE, L. *Syn.* CANADIAN ASARUM. Differs but little in appearance from the European species. It is, however, more pubescent, the flowers of a brighter hue, and the rhizome generally larger. The rhizome contains volatile oil, starch, gum, a little resin, fat, and amorphous colouring matter supposed to be asarin. In action it is milder than *A. europæum.*

ASBES'TOS. *Syn.* ASBES'TUS (ἄσβεστος, incombustible, unconsumable, Gr.), AMIANTH'US, LA'PIS A., &c., L.; ASBESTE, AMIANTE, Fr.; ASBEST, STEINFLACHS, Ger. It occurs in three forms—(1) fibrous, (2) floss, and (3) powder. The first variety is found chiefly in the Valtellina and the Valley of Aosta, in the former 5500 feet above the level of the sea. It is embedded in serpentine rock, from which it is mined by blasting with dynamite. The rock of the tableland of Acqua Nera, 6500 feet above the sea level, is also rich in fibrous asbestos; and in the Valley of Aosta it is also found, in much similar positions to that in the Valtellina. The material obtained from these Italian sources is a silicate of lime and magnesia, with about 2½% of alumina, 3% of oxide of iron, and smaller percentages of potash and soda. Floss and powder asbestos are also obtained from Italy, as well as two other varieties—viz. mountain cork, consisting of fibres less flexible than fibrous and floss asbestos, and of a brown or dirty white colour. This variety swims on water. Mountain leather, a similar variety, occurs in sheets. Canadian asbestos is much inferior to the Italian, being brittle and of short fibre. It is obtained from the province of Quebec exclusively. It differs materially in chemical composition from Italian asbestos, there being almost double the percentages of alumina and oxide of iron, and only traces of potash. Recently asbestos has been brought from Cape Colony, but it is of a very inferior character, and contains 39% of oxide of iron.

The principal use of asbestos is as a fireproof material, for which purpose it has been employed from very early times. The ancient Romans and Greeks knew how to make asbestos cloth, and specimens of their manufacture are still preserved. The Greeks used it as winding-sheets for their dead. In modern times the cloth has been introduced for fire- and acid-proof dresses, and one important application of it is as a packing material for piston-glands of steam engines. A millboard made from asbestos is largely used as a jointing for steam pipes, for gas shades, and instead of wire gauze as a support for glass vessels over burners in the laboratory. Floss asbestos is used for gas stoves, and as a non-conductor of heat for covering steam pipes, roofs in warm climates, &c.; asbestos powder is made into fireproof paint, and is very useful as a filtering medium.

ASCARIDES (ἀσκαρίς, a kind of worm, Gr.). By long usage this term is often used to designate *thread-worms* or *seat-worms;* these do not belong to the genus *Ascaris,* but to the genus *Oxyuris.*

ASCARIS LUMBRICOIDES. A parasite belonging to the genus *Entozoa,* commonly known as the round-worm, and found in the intestines of man, the horse, the ox, the pig, and some other of the lower animals. It is of a greyish-red colour, and in size and general appearance like the common earth-worm.

Children are very frequently infested by them. Their usual habitat is the small intestines, but they are occasionally found in the stomach, and have been known to transport themselves into the gall-ducts, frontal sinuses, nostrils, and mouth. The males are smaller than the females and much more rare. The females produce eggs in great numbers, but it is doubtful if the young are ever developed in the intestine in which the parent worm dwells.

It is probable that the ova gain access to the

intestines of the animals of which they eventually become the pests, from various outer sources. They are said to be very frequent in persons who partake much of raw leaves and roots. Dr Paterson, of Leith, noticed that families who drank certain water from a well supplied from a dirty pool, which contained various vermiform animalcules, were much infested with this particular species of intestinal worm; whilst others in the same street, who had recourse to a different water supply, entirely escaped. For medicinal treatment, see WORMS.

ASCARIS MYSTAX. A parasitic round-worm infesting the cat. It has been also occasionally found in man.

Ascaris mystax, according to most helminthologists, is only a variety of *Ascaris marginata*, found in the dog. The males are about 2 to 2½ inches in length, and the females sometimes as much as 4 inches. 3 gr. of santonin, followed by castor oil, or a saline purge administered twice or thrice daily for a few days in succession, will generally expel the true Ascaris.

ASCITES (ἀσκός, a leather bottle). *Syn.* DROPSY OF THE PERITONEUM; HYDROPS PERINEI vel ABDOMINIS, HYDROPERITONEUM; ASCITE, Fr.; DIE BAUCHWASSERSUCHT, Ger. See DROPSY.

ASEPTOL. *Syn.* SULPHO-CARBOL, HYDROXYPHENYL SULPHUROUS ACID, ACIDUM SOZOLICUM. $C_6H_4(OH)SO_2H$. Prepared by mixing chemically equivalent parts of strong sulphuric and pure carbolic acids, removing excess of sulphuric acid by shaking with carbonate of barium. It represents a thick fluid, with a faint odour of carbolic acid, red in colour. Sp. gr. 1·45. It is employed as an antiseptic, and does not possess the toxic action of carbolic acid, and is reported to be more powerfully antiseptic.

ASH. *Syn.* FRAX'INUS, L.; FRÊNE, Fr.; ESCHE, Ger. The popular name of several species of valuable hardy trees bearing apetalous flowers (except in the 'flowering ash'), belonging to the Nat. Ord. *Oleaceæ* (DC.), and genus *Fraxinus;* but appropriately the—

Ash. *Syn.* COM'MON ASH; FRAX'INUS, F. EXCEL'SIOR (Linn.), F. APET'ALA (Lamb.), F. OR'NUS (Scop.), L.; FRÊNE, F. COMMUN, Fr.; GEMEINE ESCHE, Ger. A large tree common to our woods and hedges; timber (ASH or ASH-WOOD) used by carpenters, cabinet-makers, and machinists, and much esteemed for its great toughness and elasticity; bark febrifuge, diuretic, resolvent, and tonic; has been successfully exhibited in agues; seeds acrid, bitter, and diuretic; leaves purgative, diuretic, and febrifuge, sometimes used instead of senna. In Southern Europe it exudes an inferior kind of MANNA, and its medicinal properties are much greater than in our climate.—*Dose* (leaves), ¼ *oz.* to 1½ *oz.* (made into an infusion), as a purge; seeds, 1 dr., as a diuretic, &c.

Ash, Flow'ering. *Syn.* MAN'NA ASH; FRAX'INUS OR'NUS (Linn.), L. A small tree of Southern Europe. Yields MANNA. The 'round-leaved flowering ash' (CALA'BRIAN ASH; FRAX'INUS ROTUNDIFO''LIA, Lamarck) is a smaller variety of the preceding, and a native of Calabria and the Levant. Said to yield the best MANNA. The 'small-leaved flowering ash' (FRAXINUS PARVIFO''LIA, Lam.) is another manna-yielding species, indigenous to Asia Minor.

Ash, Mountain, or rowan tree (*Pyrus aucuparia*, Gaert.). Useful as a nurse-tree in plantations, enduring severe exposure. Formerly regarded as a charm against witchcraft, &c.

ASH. Ashes (which *see*).

Ash, Volcanic. The name applied to the pulverulent portion of matter thrown out by volcanoes. Volcanic ash is not a uniform product, but differs much in colour, structure, and composition. It is a mechanical mixture of minerals and rocks abraded by trituration against each other.

ASH-BALLS. The ashes of land-plants, especially ferns, damped and made into balls. Used as a substitute for soap in washing, and in cleaning paint. Now almost gone out of use, owing to the general introduction of washing soda.

ASH'ERY. [Amer.] A place where potash or pearlash is made or kept.

ASH'ES. [Eng. pl.] *Syn.* ASH; CI'NIS, L.; CENDRES (*pl.*), Fr.; ASCHE, Ger. The remains of anything burned. The word 'ashes,' used alone, generally means coal ashes. In *antiquity*, the remains of a body consumed on the funeral pyre; and hence, figuratively, the remains of the dead. Although the word, in English, has—properly speaking—no singular, the term 'ash' is very commonly used. We also talk of pearlash, potash, or pot-ashes, soda-ash, &c.

Ashes of Plants. All vegetable substances contain a certain amount of mineral matter, which remains behind as ash when they are incinerated. Thus:

		Total Ash.
Cayenne pepper	yields	5 to 6 per cent.
Chicory	„	5 „
Cocoa	„	3 to 4 „
Coffee	„	4 „
Flour	„	·7 to 1·5 „
Mustard	„	3 to 4·5 „
Pepper	„	4·3 to 5 „
Rice	„	5 „
Tea	„	5·6 „
Turmeric	„	5 to 6 „
&c. &c.		

The following table gives the chemical composition of the ash of a few plants. See also MANURES, VEGETATION, &c.

A careful determination of the ash of different plants, &c., is of the utmost use to the analyst, as it aids him materially in detecting adulterations. For, the percentage of ash yielded by a plant or by any particular portion of it is constant within certain limits; and, further, the different proportions of the components of the ash are likewise tolerably constant. Again, a knowledge of the composition of the ash of any plant, grown under normal conditions, enables the practical agriculturist to apply to the soil the proper manure for that plant.

The ashes of plants (and of coal) are of course in themselves valuable as a manure. In addition to their direct manurial value as plant food, and to the effect which they have in accelerating the decomposition of mould, they also act mechanically in keeping a heavy soil porous. In the case of low-lying lands they are particularly suited for very damp clayey soils. In Picardy the ashes of

	Peas.	Beans.	Red Clover.	Sainfoin.	Wheat, Grain.	Straw.	Barley.	Oats.	Turnip Roots.	Turnip Leaves.	Beet (root).	Carrot (root).	Potatoes.[1]	Lettuce Leaves and Stalks.[2]	Olive-tree Wood.[3]	Hops.[4]	Hay.[5]	Clupea Sprouts.[6]
Potash, K_2O	42·43	36·72	18·44	31·90	29·76	10·51	20·07	17·70	23·70	11·56	21·68	37·55	25·41	22·37	20·60	24·88	11·93	17·23
Soda, Na_2O	3·27	0·14	2·79	...	5·26	1·03	4·56	3·84	14·75	12·43	3·13	12·63	...	18·50	...	...	1·07	1·19
Lime, CaO	5·73	12·06	35·02	24·30	2·88	5·91	1·48	3·54	11·82	28·49	1·90	9·76	2·34	10·43	63·02	21·59	14·76	23·57
Magnesia, MgO	5·92	6·00	11·91	5·03	11·06	1·25	7·45	7·33	3·28	2·62	1·79	3·78	4·17	5·68	2·31	4·69	5·30	3·01
Sesquioxide of iron, Fe_2O_3	0·44	0·65	0·98	0·61	0·23	0·07	0·51	0·49	0·47	3·02	0·52	6·74	0·50	2·82	...	1·75	2·75	0·28
Sulphuric anhydride, SO_3	6·23	4·28	3·91	3·28	0·11	2·14	0·79	1·10	16·13	10·36	3·14	6·34	4·71	3·85	3·09	7·27	0·20	...
Silica, SiO_2	1·74	1·52	4·03	3·22	2·23	73·57	32·73	38·48	2·69	8·04	1·40	0·76	3·64	11·86	3·82	19·71	53·43	...
Carbonic anhydride, CO_2	4·38	1·63	12·92	15·20	0·22	...	...	...	10·47	6·18	15·23	15·15	...	...	...	2·17	...	...
Phosphoric anhydride, P_2O_5	29·92	33·74	5·82	9·35	48·21	5·51	31·69	26·46	9·31	4·85	1·65	8·37	10·38	9·38	4·77	14·47	6·34	43·52
Chloride of potassium, KCl	...	...	...	6·24	...	...	...	0·92	...	...	...	...	12·40	...	1·09	...	...	...
Chloride of sodium, NaCl	...	3·26	4·13	0·78	...	...	...	...	7·05	12·41	49·51	4·91	Trace	15·09	...	3·42	2·27	11·19
Total amount	99·96	100·00	99·95	99·96	99·96	99·99	99·98	99·96	99·93	99·96	99·96	99·99	100·00	99·99	100·00	99·95	100·00	100·00
Percentage of dry ash in dry substance	2·60	2·90	7·87	6·37	2·05	...	2·50	2·50	6·00	16·40	11·32	5·12	4·86	...	0·58	5·95	6·97	...
Percentage of ash in the fresh substance	2·24	2·54	6·77	5·65	1·81	...	2·25	2·27	0·75	1·97	1·02	0·77	...	...	...	...	6·15	...

[1] Griepenkerl. [2] Griepenkerl. [3] A. Müller. [4] Way. [5] Hubert. [6] Way.

turf are made use of; while in England, the Low Countries, and the north of France, coal ashes are employed. When coal ashes are mixed with excrement, they not only help to disinfect the latter, but the mixture makes an excellent manure.

ASH-PITS. The old form of ash-pit, consisting of a large walled space in close proximity to, or actually forming part of a dwelling-house, with an earth floor and the bricks set in common mortar, without ventilation, and with only one small door through which it was just possible for a man to enter, is an abomination which ought never to be permitted, and which, thanks to recent sanitary legislation, is rapidly vanishing in England. These large ash-pits, constructed as described, and capable of containing the ashes and refuse of a large household for several months, can only be regarded as an example of the extreme carelessness of private individuals in regard to their sanitary surroundings. In the first place, these receptacles are not only for ashes, but for animal and vegetable refuse of all kinds—not infrequently slops, tea-leaves, and other liquid refuse which the domestics of a house are usually only too prone to dispose of in the easiest manner, without the slightest regard to consequences. The recognition of the fact that this will occur, unless active means are taken to prevent it, represents perhaps one of the greatest modern advances in sanitary science. The old ash-pit quickly became a bed of putrid and stinking organic matter; whilst the fluid exudations from it, soaking through the badly constructed walls and earth floor, served for the propagation of all manner of organisms, moulds, and fungi, and as a source of offensive exhalations, and their natural consequence, disease. When, in addition to this, as used only too often to be the case, the ash-pit was in connection with a common privy, the abomination and danger to health was practically perfect. The remedy is of two kinds.

1. To abolish such ash-pits entirely, and to provide in their place small iron receptacles or dust-bins which will not contain more than a few days' refuse, and to have these emptied at frequent and regular intervals.

2. Where a larger receptacle is necessary, to construct it of good brick with a thick and well-made concrete floor, the bricks of the inner walls set in cement and the interior lined with the same material, with provision for the rapid drainage of any liquid, which should if possible not be allowed to be put in it; and instead of the small aperture of the old ash-pit, one of considerable size; and if the place be covered, which is desirable to prevent the entrance of rain-water, ample means of ventilation should be provided. In all cases such receptacles should not be larger than is absolutely necessary, and should be thoroughly emptied, cleaned, and disinfected with quicklime or other suitable materials at frequent intervals, more especially in warm weather.

Section 42 of the Public Health Act provides that "every Local Authority may, and when required by order of the Local Government Board *shall*, themselves undertake or contract for,

"1. The removal of house refuse from premises.

"2. The cleaning of earth closets, privies, ash-pits, and cesspools."

By section 43, "if a Local Authority, who have themselves undertaken or contracted for the removal of house refuse from premises, or the cleansing of earth closets, privies, ash-pits, and cesspools, fail, without reasonable excuse, *after notice in writing* from the occupier of any house within their district, requiring them to remove any house refuse, or to cleanse any earth closet, privy, ash-pit, or cesspool belonging to such house or used by the occupiers thereof, to cause the same to be removed or cleansed, as the case may be, within seven days, the Local Authority shall be liable to pay to the occupier of such house a *penalty* not exceeding *five shillings* for every day during which such default continues after the expiration of the said period."

Section 44 provides that "where the Local Authority do not themselves undertake or contract for the removal of *house refuse* from any premises, the cleansing of *earth closets, privies, ash-pits*, and *cesspools* belonging to any premises, they may make *bye-laws* imposing the duty of such cleansing or removal at such intervals as they think fit on the occupier of any such premises."

By section 45, "any Urban Authority may, if they see fit, provide in proper and convenient situations receptacles for the temporary deposit and collection of dust, ashes, and rubbish; they may also provide fit buildings and places for the deposit of any matters collected by them in pursuance of this part of this Act."

By section 47, "any person who in any *urban* district allows the contents of any water-closet, privy, or cesspool to overflow or soak therefrom shall, for every such offence, be liable to a penalty not exceeding *forty* shillings, and to a further penalty not exceeding *five* shillings for every day during which the offence is continued; and the Urban Authority shall abate or cause to be abated every such nuisance, and may recover in a *summary* manner the expenses incurred by them in so doing from the *occupier* of the premises on which the nuisance exists." See NUISANCES, FILTH REMOVAL, MANURE, REMOVAL OF.

ASPAR'AGINE (-ă-jĭn). $C_4H_8N_2O_3$, = $C_2H_3(NH_2)(CO\text{-}NH_2)(COOH)$. [Eng., Fr.] *Syn.* AMIDO-SUCCINAMIC ACID; ASPARAGI'NA, ASPARAGI'NUM, L.; AGÉDOÏLE, Fr.; SPARGELSTOFF, Ger. A peculiar azotised compound, isomeric with malamide, $C_2H_3(OH)(CO\text{-}NH_2)_2$, discovered by Vauquelin and Robiquet in asparagus, and since found in the potato, marsh-mallow, liquorice-root, climbing vetch, and numerous other plants. It occurs in the juice of most plants. Many plants which do not naturally contain it may be made to yield it by growing them in dark damp cellars; whilst many, which only normally contain it in very small quantities, are found to yield much more when allowed to vegetate in the same manner.

Prep. 1. From ASPARAGUS SPROUTS:—The expressed juice, after being heated to the boiling-point (to coagulate albumen) and carefully skimmed and filtered, is evaporated at a gentle heat to a syrupy consistence, and then abandoned to spontaneous evaporation in a warm dry atmosphere for several days. The resulting crystals are purified by cautious washing in very cold

water or very strong alcohol, re-solution, and re-crystallisation.

The following are cheaper and more convenient processes:

2. From MARSH-MALLOW ROOT:—(*a*) The root (chopped small or grated) is macerated for several days in milk of lime, in the cold, the filtered liquid precipitated with carbonate of ammonium, and the clear solution evaporated in a water-bath, and otherwise treated as before.

(*b*) From the expressed juice, 2 parts; milk of lime, 1 part; agitated well together; the liquid portion, after some hours, being decanted, filtered, and evaporated, &c., as before.

3. From the ETIOLATED SHOOTS OF VETCHES:—The expressed juice of the young shoots, when from 2 or 3 to even 12 or 15 in. long, is gently simmered for 8 or 10 minutes, to coagulate the albumen; and, after straining or clarification, the clear liquid is gently evaporated to the consistence of a thin syrup, and set aside to crystallise as before. The resulting brown crystals are purified by washing with very cold water, re-solution in boiling water, and re-crystallisation, as in No. 1; or, and what is better, the hot liquid, before evaporation to a syrup, is digested for a short time with a little pure animal charcoal in coarse powder, and then filtered, when large and beautifully white crystals are obtained by the first operation. This use of animal charcoal may also be advantageously extended to the other formulæ. An excellent and very economical process.

Prop., &c. Crystals (brilliant, transparent, colourless, trimetric prisms) containing 1 mol. aq.; slightly acid to test-paper; having a faint, cooling, and scarcely nauseous taste; soluble in cold water; freely soluble in hot water; insoluble in strong alcohol and ether; solution unaffected by alkaline sulphides, oxalate of ammonia, acetate of lead, or infusion of galls; when triturated with quicklime, ammonia is evolved, and aspartic acid left behind; heated with water under pressure in a closed vessel, or boiled along with an acid or an alkali, or dissolved in a saccharine liquid and then submitted to fermentation, it is likewise converted into ammonia and aspartic acid; aqueous solutions of asparagin and aspartic acid evolve nitrogen when treated with a current of nitrous acid, with the formation of malic acid, which remains in solution. A solution of asparagine in water or alkalies is lævo-rotatory, and one in acids dextro-rotatory.

Uses. It is sedative and diuretic.—*Dose,* 1 to 6 gr.; in dropsies, heart affections, &c.

ASPAR'AGUS. [L., Eng.] In *botany,* a genus of low, spiny plants, with scale-like leaves, many of which are shrubs and climbers, of the Nat. Ord. ASPARAGEÆ DC., LILIACEÆ, Lindl.). The following species, which is that best known in England, is, however, an exception to this description, as it is neither climbing nor spinose.

Asparagus Officina'lis, Linn. [L.] *Syn.* ASPAR'AGUS, COMMON A., GARDEN A., SPAR'AGUS§, SPAR'ROW-GRASS§, SPER'AGE†§; ASPERGE, Fr.; SPARGEL, Ger. A well-known perennial plant, and one of the oldest and most delicate of our culinary vegetables. Young shoots, from the underground eyes (TURIO'NES ASPAR'AGI, L.), the asparagus of our tables; diuretic; communicate a peculiar fœtid odour to the urine, and, when eaten in excess, occasion bloody urine and accelerate fits of gout; formerly esteemed emmenagogue and aphrodisiac.—*Root* (RA'DIX ASPAR'AGI, L.), properties resemble those of the young shoots, but stronger; one of the five 'greater aperient roots' (RAD'ICES APERIEN'TES QUIN''QUE MAJO''RES L.) of old pharmacy. The tops and roots, though no longer officinal in the British Pharmacopœias, are both occasionally employed as popular remedies in dropsy and stone—the first being eaten in the usual way at table; and the second made into an infusion or decoction ($\frac{1}{2}$ *oz.* to the pint), taken *ad libitum.*

As an article of food, asparagus, in moderation, is both wholesome and nutritious. The wild varieties are largely used as vegetables in Italy, and when properly cooked are most excellent. It is cooked by simply boiling it rather quickly until tender, like the other soft green vegetables; and is either served up plain, or on toast with melted butter or sauce Hollandaise in a boat (*Soyer; Rundell*). When very small and green it is frequently dressed and served like green peas the tender portion of each shoot being cut into bits of equal size, and about 1-3rd of an inch long (*Miss Acton*).

Choice, &c. "The large grass is generally preferred, although the smaller has the fullest flavour for a dish" (*Soyer*). Unlike other plants, the *Asparagus officinalis* has not produced a single well-marked permanent variety by cultivation.

Asparagus has long been cultivated in England as a favourite vegetable; it grows wild on the coasts of Britain, and was highly esteemed by the ancient Greeks and Romans, being mentioned in the writings of Cato, Columella, and Pliny. There are several varieties cultivated by gardeners, as the giant, the white, the common green, the large purple or Dutch, and the Ulm, which may be divided into two classes—the red and the green; the former is larger and more saleable, but the latter has a superior flavour.

The drawback to its cultivation is the time required for the establishment of a bed, viz. three years. The beds require to be made in a particular manner, as follows: the intended site is dug out to the depth of several inches, and the soil so removed is mixed with a quantity of sea sand and well-rotted manure; one- or two-year-old plants are then set in rows at about nine inches apart; seedlings should be planted in March or April, or even up to the beginning of June, great care being taken not to break the rootlets, which are very brittle. Very little time is saved by planting, as the growth of the plant is stopped by the removal, and a bed which has been raised from seed will yield almost as soon as one which has been planted. Five square poles of land planted with sixteen hundred plants will yield from six to eight score heads during the season.

Asparagus beds must be kept free from weeds, and nothing else should be grown on them; the greatest care should be exercised in cutting the heads. None should be cut off for two years at least; the branches should never be cut in the summer, and in cutting the heads one or two

should always be allowed to remain on each stool to flower and run to seed, or the root will perish.

A well-kept bed will continue to yield for twelve or fourteen years, or even longer if well manured with stable manure every autumn.

Asparagus Petræ'a. [L.] *Syn.* ROCK ASPAR'AGUS, CORRUDA; ASPAR'AGUS ACUTIFO'LIA, L.; CORRUDE, Fr. Resembles the last in its general qualities, but is said to contain more asparagin.

ASPAR'TIC ACID, $C_2H_3(NH_2)(CO_2H_2)$. *Syn.* AMIDO-SUCCINIC ACID; ACIDUM ASPAR'TICUM, L.; ACIDE ASPARTIQUE, Fr. An acid first obtained, by Plisson, from asparagine, by boiling the latter with hydrate of lead or of magnesia. It forms an important product of the decomposition of albuminoid substances by means of acids or alkalies. Rhombic crystals. Its salts are called ASPAR'TATES (Eng., Fr.; ASPAR'TAS, L. sing.). See ASPARAGINE.

AS'PEN (-pĕn). *Syn.* ASP*, TREMBLING POP'LAR‡; POP'ULUS TREM'ULA (Linn.), L.; TREMBLE, Fr.; AESPE (äspe), &c., Ger. A large tree, of the Nat. Ord. AMENTACEÆ, DC., not uncommon in the moist woodlands of England, and found native on many of the Scottish mountains. It derives its name from the trembling motion of its leaves, which, owing to the peculiar flattening of the leaf-stalks, are agitated by the slightest impulse of the air. Bark and leaves contain POP'ULIN associated with SAL'ICIN. Both bark and leaves have been used with advantage in strangury and intermittents.

ASPERGILLUM GLAUCUM, Micheli. A hyphomycetous fungus which constitutes the blue mould on cheese, bread, &c.

The genus *Aspergillus* numbers several species. *A. roseus* is found on damp paper, lint, carpet, &c.; *A. aureus* and *A. aurantiacus* on bark; *A. maximus* and *A. virens* on decaying fungi; *A. alternatus* forms minute circular patches on damp paper; *A. dubius* on dung.

ASPHYX'IA (-fĭk'-sh'ă; -fĭks'-e-ă‡). [ἀ, priv.; and σφύξις, a pulse, Gr.] *Syn.* APNŒA, Eng.; ERSTICKUNG, Ger. Literally, pulselessness; but now exclusively employed to denote the results of interruption of the function of respiration. The term apnœa is an incorrect synonym, and should not be used. Apnœa is strictly physiological, and indicates a cessation of respiration due to excessive oxygenation of the blood produced artificially.

Asphyxia may result from a number of very widely different causes—indeed, from anything soever which will interrupt or obstruct the respiration; and it is found convenient to divide these causes into two groups—*internal* and *external.*

Internal.—Paralysis of that part of the nervous system which governs respiration, as by disease of, or injury to, the medulla oblongata; paralysis of the nerves or muscles of respiration; a rigid fixation of these muscles; collapse or disease of the lungs; occlusion of the air-passages by disease or spasm of the glottis, pressure of tumour, &c.

External.—Occlusion of the air-passages by foreign bodies; pressure on the chest, too great to be overcome by the muscles of respiration; closure of the air-passages by strangulation, hanging, &c.; these act by cutting off air from the lungs. Drowning or immersion in an atmosphere devoid of oxygen acts by preventing the oxygenation of the blood.

Suppose an animal placed in an atmosphere which is either devoid of oxygen, or contains an insufficient quantity to support life; the following series of phenomena will be observed:—At first the breathing will be simply much deeper; it will then become more rapid, and the muscular movements of respiration more pronounced and violent, until as the oxygen, if there be any, is almost consumed, every muscle in the body which can in any way assist in the expansion of the chest wall is brought into play. This condition is called dyspnœa. These regular efforts pass into regular convulsions, in which the effort of expiration is most marked; that is to say, the animal is making violent, reflex efforts to get rid of the excess of carbonic anhydride in the lung. By these efforts the external sphincters are generally overcome, and the urine and fæces are voided. After this convulsive stage there follows a state of insensibility, and the animal exhibits no movements except those of *inspiration,* which are irregular and spasmodic. They gradually become shallower and more irregular, and are followed by stretching convulsions. The mouth gapes, the nostril dilates, and the head is thrown back. The heart still continues to beat after all movement has ceased. In this stage, if prompt and energetic measures be taken for filling the lungs with oxygenated air, the animal may be restored to life. Without this the heart stops in diastole and death is complete. These phenomena occur more or less rapidly in all cases of complete obstruction of the air-passages, whether due to disease, the presence of foreign bodies, or strangulation. The modifications which occur in asphyxia from drowning will be found described under DROWNING, as will also the means for restoring the apparently drowned. In asphyxia attempts to restore life will be unavailing if the heart have ceased to beat, but in those cases in which the heart is stopped by mere over-distention, bleeding from the external jugular vein should be tried before hope is abandoned. The general principle is to bring about by any possible means the introduction of air into the lungs. To effect this foreign bodies must be removed from the windpipe; if the obstruction be caused by disease, tracheotomy or laryngotomy must be resorted to. The rope or other means by which strangulation is caused must be removed, and artificial respiration employed to restore the natural function. This will be described under DROWNING and RESPIRATION, q. v.

ASPHYX'IATED. *Syn.* ASPHYXIA'TUS, L.; ASPHYXIÉ, Fr.; ASPHYKTISCH, SCHEINTODT, &c., Ger. Affected with or labouring under asphyxia. (See *above.*)

AS'PIC†. Spike lavender or French lavender; also the male lavender, spica nardi, or pseudonardus of old writers.

Aspic. In *cookery,* "savory jelly extracted from the succulence of meat" (*Soyer*).

Prep. (*Miss Acton*). Calf's feet, 2 in no.; veal, 4 *lbs.*: ham, 3 *lbs.*; onions, 2 (large); carrots, 3; water, 1 gall.; boil five or six hours, or until reduced to less than one half, strain, and when

cold put the jelly into a stew-pan with the whites of four eggs well beaten, a large bunch of savoury herbs, 3 blades of mace (in shreds), a teaspoonful of white peppercorns, and salt, a sufficiency; keep it well stirred until pretty hot, then let it gently simmer for about fifteen minutes, and, after settling, pass it through a jelly-bag till quite clear. After cooling a little it is fit for use; or it may be allowed to cool and be at any time re-melted. French cooks commonly flavour it with Tarragon vinegar, added after clarification.

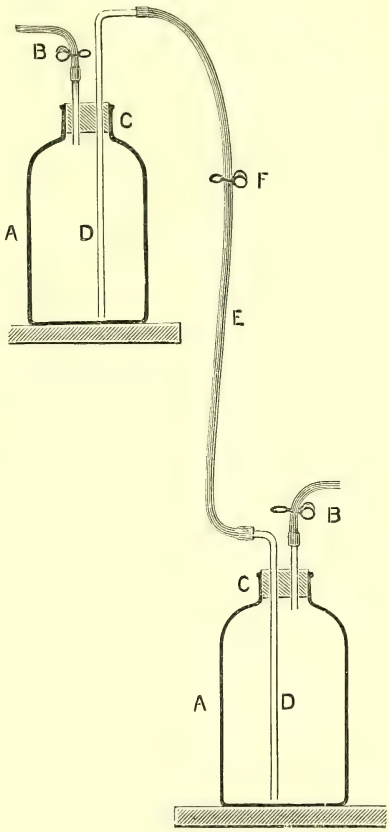
Uses, &c. "Cold poultry, game, fish, plovers' eggs, truffles, and various dressed vegetables, with many other things often elaborately prepared, and highly ornamental, are moulded and served in it, especially at large *déjeûners* and similar repasts. It is also much used to decorate raised pies and hams, and for many other purposes."

ASPIDOSPERMINE. *Syn.* ASPIDOSPERMINA. An alkaloid, one of the active principles of white Quebracho bark, *Aspidosperma Quebracho*. Sulphate of aspidospermine is the commercial salt; it is a crude substance, being a mixture of five or six alkaloids.—*Dose*, $\frac{1}{60}$ to $\frac{1}{30}$ gr. hypodermically. Used to lower temperature in fevers where quinine fails.

ASPIRATOR. An apparatus, first devised by Brunner, for drawing a stream of air through a tube or other vessel. There are, of course, various forms of aspirators, but that invented by Brunner is perhaps one of the most convenient. It consists of two cylindrical vessels of equal volume placed one above the other, and communicating by tubes which can be opened or closed, so that when the water has run from the upper to the lower vessel the apparatus (which turns for the purpose on a horizontal axis) may be inverted, and thus the empty vessel brought to the lower level and the full one to the higher; by this means the water can be made to flow again without the trouble of refilling the apparatus. Such an aspirator can be made quite easily out of two Winchester quart bottles, as is shown by the accompanying engraving. A, A are the bottles, one of which is filled with water. B, B are glass tubes with stopcocks (which are to be preferred to clips), which can be opened or closed as desired. If no glass stopcocks are available, a simple piece of glass tubing, bent at right angles, may be substituted; but it is more convenient to have them. C, C are caoutchouc stoppers, and D, D glass tubes which reach to the foot of the bottles, and which are connected together by the long india-rubber tube E. F is a clip for regulating the rate of aspiration. Before changing the levels of the bottles, clip F must of course be closed.

Water-pumps are also very convenient to use for aspirating. See AIR-PUMP; FILTRATION; AIR, ANALYSIS OF.

In *surgery*, an instrument for evacuating abscesses and cavities containing fluid. It consists essentially of a stout bottle, which can be emptied of air by means of a small pump and the vacuum secured by means of a tap. The pump is removed, and a tube with a suitable perforated needle is connected with the tap. The needle is then plunged into the abscess, pleural, or other cavity containing fluid which it is desired to remove. The tap is turned, and the hollow needle put in communication with the vacuum, and by this



means the fluid can be withdrawn, without the necessity of making large incisions, even from deep-seated parts.

ASPHALTE or ASPHALTUM. *Syn.* ASPHALT, BITUMEN, COMPACT BITUMEN, MINERAL PITCH, JEW'S PITCH, FOSSIL BITUMEN, VITREOUS B., &c.; ASPHALTUS, BITUMEN FOSSILE, B. JUDAICUM, B. SOLIDUM, B. VITREUM, MURINA, M. MINERALIS, &c., L.; ASPHALTE, BITUME MASSIF, B. SOLIDE, POIX JUIVE, &c., Fr.; ASPHALT, ERDPECH, JUDENPECH, ERDTHEER, &c., Ger.

A smooth, hard, brittle, black, resinous mineral, with a conchoidal fracture; a freshly broken surface of the mineral shows a darker streak than one which has been kept for some time.

Sources. Asphalte occurs in various parts of the world in a more or less pure condition. Rocks impregnated with it are known as earthy or crude asphalte. The purest asphalte is found on the shores of the Dead Sea. It issues in the liquid form at the bottom of the lake and, rising to the surface, solidifies into lumps which collect along the shore. In Trinidad there is a lake of asphalte $1\frac{1}{2}$ miles in circumference, solid near the shores but getting gradually warmer and softer towards the centre. Asphalte is also found in Cuba and

South America. In Europe, at Seyssel near the Rhone, there is a deposit 2500 ft. long and 800 ft. broad. At Bechelbrunn and Lobsann in the Lower Rhine a thick bituminous mass occurs, which is known as *graisse de Strasbourg;* and in the Val de Travers, Neufchatel, a cretaceous formation impregnated with asphalte. The latter is used for building purposes and for making pavements (see *below*). In the British Isles asphalte is found at the Poldice mine in Cornwall, near Matlock in Derbyshire, in Shropshire, and at the hot wells near Bristol.

Much of the bitumen of commerce is greatly adulterated or is even entirely factitious, being made by mixing earthy matter with the high-boiling residue or pitch left in the distillation of coal-tar.

Prop. Odour bituminous, becoming stronger by friction. Sp. gr. 1 to 1·68. Melts at 100° C., takes fire easily, and burns with a bright smoky flame. It is itself a product of the decomposition of vegetable matter, and gives, when submitted to destructive distillation, products similar to those obtained from coal. The behaviour of asphalte with regard to solvents varies somewhat, according to the source from which it is derived. It is only partly soluble in alcohol and ether, but much more so in benzene, turpentine, and essential oils, and it dissolves completely and easily in chloroform, carbon bisulphide, and the different mineral oils; it is also soluble in carbonated and caustic alkalies. Hot concentrated sulphuric acid decomposes and dissolves it, but strong nitric acid, even when warm, has no effect upon it, and it is this fact which makes bitumen so useful in etching and similar processes. Chlorine and iodine harden bitumen and render it insoluble.

The following analysis by Boussingault of a specimen of asphalte from Peru will give an idea of the composition of the purest varieties:

Carbon	88·63	88·70
Hydrogen	9·69	9·68
Oxygen, Nitrogen	1·68	1·62
Ash	...	...
	100·00	100·00

According to the same authority, asphalte consists of a volatile oil, petrolene, $C_{20}H_{32}$, boiling at 280° C. (536° F.), and a non-volatile resinous substance, asphaltene, probably produced by the oxidation of the above oil. Recent researches of Dr Kayser of Nüremburg have, however, shown the entire absence of oxygen in several different samples examined by him; but he invariably found a considerable proportion of sulphur, amounting to as much as 10% in the Syrian and Trinidad asphaltums. Helm and Delachanal have found the same element, which may easily be discovered by heating asphalte on a piece of clean silver, which is thereby blackened; and there seems good reason to believe that asphaltum is formed by the action of sulphur on petroleum under the prolonged influence of a high pressure and a high temperature.

The European varieties of asphalte are far from pure, generally containing more or less admixed earthy matter. The following analyses show the composition of the more important natural asphaltes:

	Bitumen of Bastennes.	Bitumen of Pont de Château, Auvergne. Crude.	Pure.	Bitumen of Abruzzi. Crude.	Pure.	Bitumen of Monastier, Haute-Loire
Oily matters } Bitumen	20·0	—	—	—	—	7·0
Carbon } Bitumen	3·7	76·13	77·5	77·64	81·8	3·5
Hydrogen	—	9·41	9·6	7·86	8·4	—
Nitrogen	—	12·66	12·4	1·02	1·0	—
Oxygen	—		0·5	8·35	8·8	—
Water	—	—	—	—	—	4·5
Gas and vapour	—	—	—	—	—	4·0
Quartz sand and mica	76·3	—	—	—	—	60·0
Clay		—	—	—	—	Ferrug. 21·0
Ashes	—	1·80	—	5·13	—	—
	100·0	100·0	100·0	100·0	100·0	100·0

Asphalte may be purified by heating with water, by dissolving out the earthy matter (if calcareous) with hydrochloric acid, or by dissolving out the asphalte by means of oil of turpentine and afterwards distilling off the solvent.

The first method is employed at the asphalte works at Seyssel and Bechelbronn. The crude material is first heated with water, when the asphalte melts and rises to the surface, whilst the earthy matters remain at the bottom. On cooling, the cake of bitumen can be easily removed (a natural purification of this sort goes on in the Dead Sea). The bitumen is then again melted, and heated until the water and more volatile constituents have been driven off.

Uses. The chief interest in bitumen attaches itself to the fact that it formed the sensitive material in the first photographic process given to the world, viz. that of Joseph Nicephore Niépce, of Chalons-sur-Saone, which dates back to 1814. This process depends upon the fact that certain portions of bitumen, extracted by suitable solvents, have the property of becoming insoluble under the influence of light. This was utilised by coating metal plates with the prepared bitumen, exposing them in the camera, and then dissolving off the unaltered portions (representing the shadows), when a picture in relief was obtained. The exposure required was necessarily very long, and the process was abandoned when Daguerre discovered the means of developing the latent image produced when the haloid salts of

silver are exposed to light. Although the use of bitumen has been entirely abandoned for the production of direct photographic images, it is still employed for plate-etching purposes, for which it is well adapted. The following abstract of a description, by Major J. Waterhouse, B.Sc., from the 'Year-book of Photography' for 1884, will give the main details of the application of bitumen for this purpose.

Bitumen, when treated with different solvents, gives products varying considerably in composition and sensitiveness. The alcoholic extract is quite insensitive to light, the ethereal one only slightly so. The residue left from these two solvents is very soluble in chloroform, less so in turpentine, benzene, and essential oils; it is resinous, very brittle, black, and odourless. Thin films of it are very sensitive to light, and solutions of it in chloroform show no absorption bands whatever when examined with the spectroscope. All the above extracts contain sulphur, the largest amount being present in the last. The greatest proportion of sensitive material is found in Syrian asphaltum, which should therefore be used for photographic purposes. It can be obtained from Romain Talbot of Berlin, and from Dr Schuchardt of Gorlitz.

In order to make the sensitive solution, a good specimen of bitumen is powdered and extracted with benzene (commonly called benzole, not benzoline), and about 10% of oil of lemons is added. The strength of the solution depends upon the work to be done. If it is to resist weak acids, as in photo-zincography, it should contain from 2% to 5% of extractive; but if strong acids are to be used, as in copper-plate etching, it should contain from 5% to 10%. The solutions must be carefully filtered and kept in the dark; as they do not keep well, they should be made fresh for use. The metal plates having been prepared in the usual way, they are next coated in a weak light with the benzene solution, and dried in the dark. Since the benzene does not evaporate so rapidly as the ether of collodion, it is necessary to use a whirling table to keep the film even until it has to some extent set, the plate being then removed and allowed to dry completely. The benzene must be free from dissolved water, or streaks will form when the films are dried.

Exposure to Light. The negatives (copies of line drawings) should if possible be stripped cliché-films, as there is some difficulty in getting perfect contact between metal plates and negatives on glass. They should be moistened before being used, and fixed to the sensitive surface by fastening down the edges with gummed paper. The cliché should on no account be gummed to the metal plate, since the gum would entirely stop the action of the light on the asphaltum surface. If ordinary glass negatives are used, the negative and asphaltum surface should be well rubbed with French chalk to prevent adhesion. The length of exposure depends upon the quality of the bitumen, the thickness of the coating, the strength of the solvent to be used, the intensity of the light, and the quality of the negative, and can only be ascertained by experiment. It varies from a quarter of an hour in the sun to two or three hours in the shade for a clear line subject. Plates of metal coated with the varnish may be used as an actinometer, or the corner of the plate may be rubbed from time to time with cotton-wool dipped in turpentine. If the varnish rubs off, the exposure is insufficient. For development turpentine is used. Benzene is too powerful a solvent, but a little of it may be added, if necessary, to hasten the action of the turpentine. The coated plate after exposure is placed face-upwards in a metal tray containing sufficient turpentine to cover it, the tray being continually rocked and the surface of the plate carefully watched. The image will soon begin to appear as the unexposed parts dissolve. As soon as the lines or ground, as the case may be, appear free from asphaltum, a final rinse may be given with clean turpentine; but at this point the greatest care is requisite not to let the action of the turpentine proceed too far, otherwise the fine parts will go, and the plate be spoilt. As soon as the proper moment arrives—or even a little before it—the turpentine must be evenly and sharply washed off under a strong stream of water from a rose jet. This should leave the metal perfectly clean and bare, except where covered with the insoluble asphaltum. If the image should not be quite clear, the plate must be dried perfectly and the operation repeated, but it requires great care. After drying again the plate is submitted to etching (which *see*) in the usual way. See PHOTOGRAPHY and PHOTO-MECHANICAL PROCESSES.

Amongst other uses for asphalte or bitumen may be mentioned the manufacture of black varnishes or japans (see *below*). The Egyptians used it in embalming under the name of Mumia; and the Babylonian builders are said to have employed it as a cement in lieu of mortar. It is, however, doubtful whether the hard semi-vitreous variety of bitumen was that which was thus employed, its present hardness being probably due to time.

The solid bitumens are now extensively employed in the manufacture of bituminous mastic or cement and similar compositions, which are used for lining water-cisterns, and for various other hydraulic purposes; also for making roofs, floors, roads, pavements, &c. For the last purpose the native varieties of 'asphaltic rock,' consisting of a mixture of bitumen and calcareous earth, when tempered with a proper quantity of crushed granite or calcareous sand or gravel, are found to be the most substantial and durable. The plan followed in laying down such pavements in Paris, where they have been most extensively adopted, is as follows:—The ground having been made uniformly smooth, it is edged in the usual manner with kerbstones rising about 4 inches above its level, and then covered to a depth of 3 inches with concrete (made with about 1-6th part of good hydraulic lime), which is well pressed down, the surface being subsequently smoothed over with a very thin coating of hydraulic mortar. On this, when perfectly dry, the 'bituminous mastic' (previously crushed sufficiently small to pass through meshes 10 to the inch in size, rendered semi-fluid by being cautiously heated in an iron cauldron, and mixed therein with sand or gravel) is evenly spread so as to form a layer three quarters of an inch, or—for less solid work—half an inch in thickness. (A small portion of mineral or

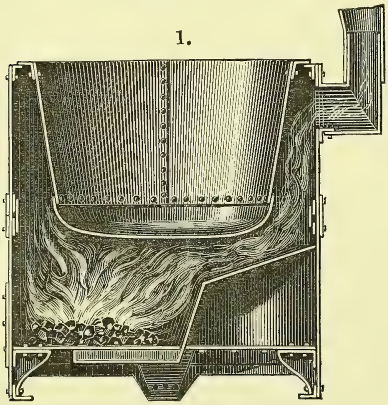
coal tar is usually added to the contents of the cauldron, to promote the fusion and render the admixture more perfect.) Some coarse sand is lastly sifted over and pressed down on the surface, and the work is then complete; in a few days the pavement becomes sufficiently compact and solid to be thrown open to foot passengers. Absolute dryness is a *sine quâ non* in the process. The mastic must also be laid down in dry weather. If laid in wet, damp, or even foggy weather, it will be liable to separate from its bed, and gradually to break up. This is the reason why so much of the asphalte and bituminous pavement laid down in London has proved a failure.

An important precaution to be observed in making asphalte pavements or roads is to boil the bitumen thoroughly, so as to expel water and volatile oils; these, if allowed to remain, are found to render the mastic more sensitive to the extremes of heat and cold, as well as less able to stand the wear and tear of traffic.

Claridge's Process. This consists in fusing blocks of mastic in a suitable boiler, similar to that seen in fig. 1, and in adding to it a quantity of mineral tar, in the proportion of 1 *lb.* of tar to every *cwt.* of mastic. 1 *lb.* of tar is first fused in the boiler, 56 *lbs.* of mastic are then introduced, and the whole repeatedly stirred so as to prevent the formation of a deposit. When the contents of the boiler are melted, the cauldron is covered over for a quarter of an hour, after which the remainder of the mastic is added, and its fusion proceeded with as before, the process being repeated until the boiler is full, allowing an interval of from ten to fifteen minutes between each operation.

When the mastic is sufficiently fluid it will drop freely from the stirrer, and jets of light smoke will be observed to issue from it. If stiff mastic is required, the proportion of tar is lessened, and a quantity of coarse grit or river sand, previously carefully dried, is added in the proportion of 20 or 30 *lbs.* to the *cwt.* of mastic.

1.

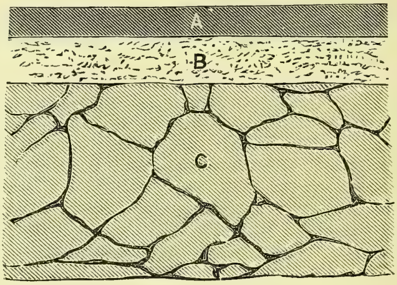


In laying the asphalte the greatest attention and care must be paid to the preparation of a solid and dry foundation.

This is usually accomplished by removing or ramming the loose earth, and placing upon the bed a layer of coarse sand mixed with powdered limestone, in the proportion of seven parts of the former to one of the latter, the whole being pressed or beaten until solid; upon this a second layer of finer materials is laid, compacted, and levelled. The bed thus prepared is allowed to dry before coating it with mastic.

Fig. 2 shows the manner in which ordinary

2.



asphalte is laid down. In this figure C is the bed of coarse concrete, B the second and finer layer of the same material, and A the layer of asphalte.

The base or concrete must be perfectly dry when the mastic is poured on, or the work will be a failure, for the moisture will be converted into steam, which, issuing through the fluid mastic, will cause the formation of holes in the latter and blister it, so that the surface will ultimately crack. To counteract in some measure the evil arising from the formation of steam, fine cinder dust is sifted over the bed of concrete previously to the application of the mastic.

When asphalting suspension bridges, a sheet of canvas is usually spread over the concrete.

In asphalting damp places, such as cellars and foundations, a brick invert is always laid in asphalte beneath the concrete. This is done by placing the bricks in rows, at the proper depth and slope, and pouring a coating of asphalte about a quarter of an inch thick upon them. Before the mastic solidifies, the bricks are separated a little by passing a knife between them, thus assisting the mastic to penetrate the interstices more thoroughly. The concrete is afterwards laid upon this bed, and the layer of mastic upon the latter in the usual way. The thickness of the layer of mastic varies according to the attrition to which it is to be subjected, but the usual depth is from a quarter to one and a quarter inches.

ASPHALTE, ARTIFICIAL. The material used for the above paving processes is generally a natural product consisting of bitumen mixed with varying quantities of siliceous or calcareous earth or of both, the state of admixture being very perfect. The same natural products are used for the manufacture of the various forms of mastic found in commerce, the material being sometimes submitted to a previous purification by means of hot water, as described above. Large quantities of mastic are now, however, manufactured from pitch (the high-boiling residue left in the retorts in coal-tar distillation) by adding to it chalk, or a mixture of chalk and sand. It is important that the pitch used for this purpose should have the proper consistency. That left in the retort after

the anthracene oils have been distilled off (see COAL-TAR DISTILLATION) is usually too fluid, and should be submitted to a further heating to expel some of the more volatile constituents. This may be performed in the vessel shown in fig. 1, the liquid being continually stirred to prevent charring. The vapours evolved, however, are likely to be a great nuisance to the neighbourhood, and it is much better to use some form of condensing arrangement. In this case the retort-head must be banked with ashes or some other non-conducting material, so as to keep it at a relatively high temperature, otherwise it will be found almost impossible to drive the vapours over, on account of their high boiling-point. For the same reasou the condensing-tube must be wide and not too thoroughly cooled, so that the vapours may liquefy but not solidify, otherwise the condenser may become choked. The condensed oils may be used for lubricating heavy machinery, for the manufacture of lamp-black by submitting them to an incomplete combustion (see ANTHRACENE and COAL-TAR DISTILLATION), and for increasing the illuminating power of gas (see COAL TAR and WATER-GAS).

The residual pitch, when cold, should be almost solid, but the right condition can only be found by practice, and it varies with the purpose for which the mastic is intended. It is again melted and heated to a high temperature, and the mixture of chalk and sand—also carefully dried and strongly heated—is gradually added under stirring. The quality of the product depends largely on the thoroughness with which the chalk and pitch have been incorporated, the operation of mixing being by no means an easy one to carry out. When the mixture appears smooth and is in a tranquil state of fusion, it is run into moulds and allowed to solidify. The hardness of the asphalte increases with the amount of chalk, but at the same time it loses its elasticity, and is more liable to crack.

Asphaltum, Facti″tious. *Syn.* ASPHAL′TUM FACTI″TIUM, L. That of the shops, when not an inferior kind of true asphaltum, is commonly made from the bottoms of Barbadoes tar and other mineral bitumens, by heating them until quite hard. Sometimes a little Scio turpentine, balsam of copaiba, or even common resin, is added. In colour, hardness, &c., it is inferior to native asphaltum.

Asphaltum, Liq′uid. *Syn.* PREPARED ASPHALTUM; ASPHAL′TUM LIQ′UIDUM, L. *Prep.* 1. Scio turpentine, 2 *oz.;* melt; add asphaltum (in powder), 1 *oz.;* mix, cool a little, and reduce with hot oil of turpentine.

2 (Wilson's). Asphaltum, ½ *lb.;* melt; add of hot balsam of copaiba, 1 *lb.;* and, when mixed, thin with hot oil of turpentine. Both the above are used as 'black japan' or 'varnish,' and as a 'glazing colour' by artists.

ASPHALTE VARNISH. The following process for preparing this mixture is given in Spon's 'Workshop Receipts,' almost exactly as follows:—Coal tar is boiled until it shows a disposition to harden upon cooling, which can be ascertained by rubbing a little of it on a piece of metal. About 20% of lump asphalte is then added, and stirred into the boiling tar until all the lumps are melted, when the mass is allowed to cool. This makes a very bright varnish for sheet metals, and it has the further advantages of being both cheap and durable.

ASSAFŒTIDA. [L. and Eng.] *Syn.* ASSAFETIDA, DEVIL'S DUNG, Eng.; ASSAFŒTIDA GUMMI, L.; STINKASAND, STINKENDER ASAND, TEUFELSDRECK, Ger. A gum-resin exuded from the excised root of *Ferula narthex* (B. P.), from *F. scorodosma,* and probably from *F. persica.* They are large perennial herbs, which die after flowering. The first is a native of dry sunny places on the northern slopes of the mountains dividing Kashmir from Western Tibet, and yields Tibetan assafœtida. The second grows on the east of the Sea of Aral, and also south-east of Samarkand; it probably extends over a wide district of South-western Asia. It furnishes Persian assafœtida. The gum-resin is collected about the middle of April, when the plant has ceased to grow. The root is cut with a sharp knife, and the juice is scraped off with a broad iron spatula and put into a cup. At each collection a thin transverse slice is taken off, which causes the juice again to flow, and this is done till the root is exhausted. The contents of the cups are emptied into large vessels, and the juice exposed to the sun to harden. Assafœtida is mostly met with in commerce in lumps, and rarely in separate tears, varying in size from that of a pea to a walnut. In India and Persia it is used as a condiment. *F. alliacea,* Boiss., from Kerman, Persia, yields the assafœtida known as Hing in the Bombay market. It is imported into Europe from Persia, *viâ* Bombay, in cases, mats, and casks. It yields its virtues to alcohol, and forms a clear tincture, which becomes milky on the addition of water.

Mr E. M. Holmes says *F. narthex* and *F. scorodosma* are so extremely similar in leaf that it may be well to direct attention to the chief distinction between the two plants. *F. narthex* has yellow petals, which are quickly deciduous, and the fruit has conspicuous vittæ, one or more between each rib of the fruit, the vittæ being slightly branched, almost like lacticiferous vessels. The umbels are regularly distributed from the bottom to the top of the stem. In *F. scorodosma* the petals are white, conspicuous, and persist even after the young fruit is formed. The fruit has no vittæ visible to the naked eye, though very small vittæ may be seen on transverse section. The umbels are collected together near the top of the stem, giving a rounded appearance to the inflorescence. The whole plant, but especially the inflorescence, is more hairy than *F. narthex.*

Comp. Assafœtida contains from 4% to 5% of a peculiar volatile oil, and from 50% to 60% of resin of a whitish colour, turning rose-red and reddish-brown by exposure to the air, and giving a greenish solution with concentrated sulphuric acid. Brande resolved this resin into two others —one soluble in ether; the other insoluble in that menstruum.

Pur. The assafœtida of the shops is generally in masses of a whitish, reddish, or violet hue, formed principally of adhering tears or grains, possesses a peculiar fœtid, alliaceous odour, and forms an emulsion with water in all proportions. Hot sulphuric acid blackens it and forms a dark

blood-red liquid, sulphurous fumes being evolved. This solution diluted with water, and then saturated with potassa, has a blue colour, which is most visible by reflected light. Digested first in alcohol, and afterwards in weak spirit and water, the residuum should not exceed 16%. Sp. gr. 1·325 to 1·330. It is frequently adulterated with inferior gums, and with chalk, clay, sand, &c. The purest and best is that which is clear, of a more or less pale red colour, full of white tears, and very fœtid.

Prop., Uses, &c. Assafœtida is stimulant, antispasmodic, emmenagogue, expectorant, aphrodisiac, and anthelmintic, and is the most powerful of all the fœtid gum-resins. It is administered with advantage in several uterine diseases, hysteria, chorea, flatulent colic, whooping-cough, infantile convulsions, spasmodic asthma, and some other affections of a spasmodic and convulsive character.—*Dose,* 5 or 6 to 30 gr., in pills, or preferably made into an emulsion; as an enema, 2 dr. of tincture, with warm water, q. s.—*Dose for Animals.* 30 to 60 grains. Some Oriental nations esteem it highly as a condiment. The Brahmins use it against flatulence, and to correct the coldness of their vegetable food. In Persia the leaves of the plant are eaten as salad, and the root after being roasted. In *cookery,* it is now frequently employed as a substitute for garlic. "I am assured by an experienced gastronome that the finest relish which a beef-steak can possess may be communicated by" (slightly) "rubbing the gridiron on which the steak is to be cooked with assafœtida."

Assafœtida, Prepared. As AMMONIACUM, PREPARED.

ASSAY (-sā). *Syn.* ESSAI (*anc.* ASAIE), Fr.; PRÜFUNG, &c., Ger. Literally, a 'trial' or examination.

In *chemistry,* the determination by any chemical means, generally by precipitation, of the proportion of any constituent which a compound substance contains. The term is more particularly applied to the determination of the more important constituents of articles which are employed on a large scale; for instance, the amount of caustic alkali in the commercial products, of available chlorine in bleaching-powder, or of oxygen in oxide of manganese. In *metallurgy,* the determination of the proportion of metal in any ore, alloy, or other metallic compound, particularly in the 'dry way,' *i. e.* by cupellation; and more especially of the proportion of pure gold or silver contained in coin or bullion. See ASSAYING.

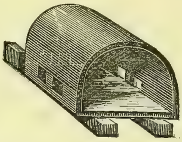
ASSAYING. *Syn.* ASSAY; COUPELLATION, Fr.; ABTREIBEN AUF DER CUPELLE, Ger. The determination of the amount of gold or silver in ores or alloys in the dry way, by oxidising and thereby removing the baser or more oxidisable metals, the residual bead of pure gold or silver—or a mixture of these—being afterwards weighed.

The operation consists essentially in placing the alloy, together with a sufficient quantity of metallic lead, in a small red-hot shallow crucible or cupel made of a porous material such as bone-ash, and heating this again to redness. The lead first melts and alloys with the gold or silver; it then begins to oxidise, the fused litharge produced by its oxidation working into the porous cupel, which readily takes it up, but whose pores are too fine to allow of the absorption of metallic lead. The oxidation of the lead also brings about that of any other oxidisable metals present, such as tin or copper, since the lead oxide readily gives up its oxygen to those metals. If, therefore, sufficient lead be used, all the impurities will sink into the cupel, together with the lead oxide, and at the end of the operation a bead of pure gold or silver or a mixture of these, as the case may be, will be left. These metals are the only ones (excepting the platinum metals, which are not usually present) which resist oxidation at a high temperature. When the resulting bead is a mixture of the two metals, the proportion in which they are present is determined by 'parting,' that is by heating the alloy with nitric acid, when the silver dissolves and the gold is left behind. Although the assay of gold and silver is simple in principle, its practical working out requires attention to a number of minute details, the chief of which is a properly regulated temperature.

The following is a description of the appliances used and the methods generally adopted.

Furnace. Any conveniently arranged furnace capable of accommodating the muffle will do, provided a red heat can be produced and maintained with tolerable steadiness during the operation. A furnace can be easily constructed of red brick, 3 ft. square externally, and having an internal measurement of 1 ft. square by 1½ ft. deep, measured from the top to the fire-bars, below which is the ash-pit with aperture for admission of air. The furnace is to be connected with a chimney 15 to 20 ft. in height, by means of a flue 12″ × 3″ in cross section. Across the furnace, a few inches above the fire-bars, is placed the *muffle, i. e.* a large tube of refractory clay having a cross section resembling a letter D in shape (see fig. 1), the cupels being laid on the

1.

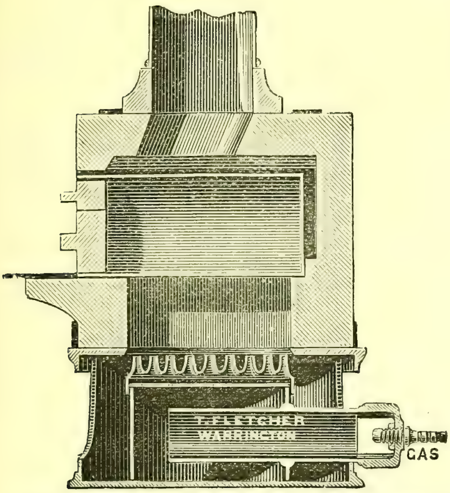


flat side. The fuel used is generally coke or charcoal. The interior of the furnace should be lined with fire-brick if it is to last for any length of time. Muffle furnaces heated by gas are very useful, as they can be started in a few minutes and the temperature be easily regulated. That of Fletcher, of Warrington, is one of the best. It is represented below (see figs. 2 and 3).

Cupels. These are made from the ashes of bones, freed from organic matter, ground and washed. Horses' or sheep's bones are said to be the best. The ground bone-ash, resembling coarse wheat flour in fineness, is mixed with sufficient water to make it cohere without being moist. It is then charged into a mould and a rammer brought down on it, the mould and rammer being shaped so that the cupel has the form represented in fig. 4. Sometimes the cupel is shaped so as to have

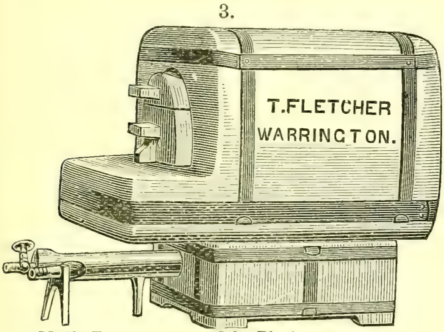
four cavities; in this case two duplicate assays can be carried on at the same time. The degree

2.



Muffle Furnace with Draught Burner, showing internal arrangement.

3.



Muffle Furnace arranged for Blast, external view.

of fineness of the bone-ash and the pressure used in ramming are matters of importance,

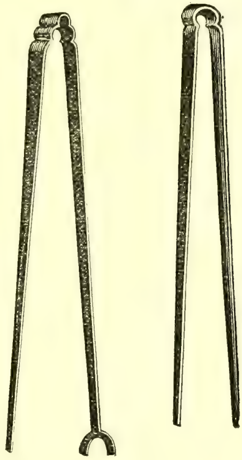
4.

since, if the pores are too fine, the cupel will crack on drying; whilst if too large, there is a risk of metal sinking into the cupel and so becoming lost. The cupels should be dried slowly, a final desiccation being effected by heating them in a furnace. Sometimes a small quantity of wood ashes or carbonate of soda is added to the water used for moistening the bone-ash. Tongs for introducing or removing cupels have a form represented in fig. 5.

Balance. The instrument used should be a bullion or button balance, enclosed in a glass case and constructed to carry not more than 5 grms. (77·19 gr.), and to turn distinctly with $\frac{1}{10}$ to $\frac{1}{20}$ milligramme when both pans are loaded with 1 grm. (15·43 gr.). If a heavy-beamed balance is used, the weighings become very tedious.

Weights. The results of a silver assay are expressed in England in silver assay 'pounds,' ounces, pennyweights, and half-pennyweights, these different denominations having the same

5.



relation to one another as the ordinary troy weights; for instance, the assay pound = 12 assay oz., the assay oz. = 20 dwts., &c. There are therefore 480 half-pennyweights or "reports" in the assay pound. The latter is usually made equal in weight to 12 gr. troy, so that the lowest report = $\frac{1}{40}$ gr. troy; but the actual amount weighed out for an assay makes, of course, no difference in expressing the proportion of pure metal. Silver is also often expressed in parts per 1000.

The gold assay 'pound' is divided into 24 carats, each carat into 4 assay gr., and each gr. into eighths, so that there are 768 reports for gold. The gold assay 'pound' is usually made to weigh 12 gr. troy, hence the lowest report will equal $\frac{1}{64}$ gr. troy.

Centner. One assay centner = 5 grms. (77·19 gr.) (Upper Harz), or = 3·75 grms. (57·89 gr.) (Freiberg). This is divided into 100 lbs., and each of these into 100 quints.

In Austrian smelting works 1 assay centner = 10 grms. (154·38 gr.) = 100 'pounds.' One pound = 32 loth, 1 loth = 4 quentchen, and 1 quentchen = 4 denär.

In America 1 assay 'ton' = 29·166 grms. (450·26 gr.). One (ordinary) ton = 2000 lbs. avoirdupois $= \frac{2000 \times 7000}{480} = 29166$ oz. (troy).

Hence, if an assay ton (29·166 grms.) be taken for assay, and the result be expressed in milligrammes, it will at once show the amount of metal in troy ounces in 1 ton of ore. For general practice it is better to use the French metric system (see WEIGHTS AND MEASURES) instead of the above arbitrary ones.

Sampling. Fused alloys when left to themselves frequently undergo a partial separation; hence ingots often have a different composition at their upper and lower sides, especially if the ingot

has been cooled slowly. This must be taken into consideration in sampling.

Sampling by Cutting. The sample, 2·5 grms. (38·89 gr.) for silver ingots, 1·5 grms. (23·15 gr.) for gold, is cut from the upper and lower edges of the bar, usually at opposite ends. The separate samples are rolled and the resulting sheets cut into shreds, ·5 to 1 grm. (7·71 to 15·43 gr.) being taken for analysis. For gold the average of the two assays is taken, whilst the lowest result is frequently taken as representing the average composition of silver ingots.

Note. The lower sample from refined Upper Harz silver is from $\frac{3}{1000}$ to $\frac{4}{1000}$ richer in gold than the upper, the percentage of gold increasing towards the bottom. The centre, as a rule, contains more silver than the edge. In the 'five-mark piece' the centre is $\frac{2}{1000}$ richer than the edge, and the same is the case with the 'thaler,' as they are stamped from a bar poorer on the edge than in the centre. For this reason, when taking samples from such coins, it is best to cut out a quadrant, cut off the corners, and assay them. In this way the assay samples represent the composition of both periphery and centre of the bar from which the coins have been stamped. Fewer differences occur in gold than in silver coins (from Kerl's 'Assayer's Manual').

Sampling by Boring. By this means a sample can be obtained from the edge to the centre, which furnishes a fairly average sample. It is, however, difficult to mix the borings thoroughly, hence it is better to fuse them under charcoal before weighing out the sample for assay.

Sampling by Dipping. A curved metal rod, such as the clean end of a pair of pincers, is immersed in the molten metal and withdrawn. When the crust has become cold it is broken off. A sample is usually taken in this way during the refining of silver, a second sample being afterwards taken from the under side of the solidified ingot.

Sampling by Granulation. This gives the most reliable value of the metal. The ingots are fused in a black-lead crucible, the molten metal stirred well, and a small sample taken from the bottom of the crucible and poured into water which is kept in gentle rotation by means of a birch broom. The granulated metal is afterwards carefully dried and a portion weighed for assay.

Silver Assay (cupriferous or fine silver, coins, refined silver, &c). In order to obtain an accurate result, it is necessary to make a preliminary assay for the purpose of finding approximately the amount of silver present, and therefore the amount of pure lead which it is needful to use; for, if too little be employed, the whole of the copper will not be removed, whilst if too large a quantity is added, silver is apt to be carried into the cupel. The silver is therefore cupelled with sixteen times its weight of lead, and the approximate amount of silver thus determined, —the details of this first assay being the same as those given below, with the exception that a larger quantity of lead is used. With silver coins, where approximate composition is known, this preliminary assay is unnecessary. The approximate amount of silver being now known, 0·5 grm. (7·71 gr.) of the alloy is weighed out together with the necessary amount of lead, as shown by the following table:

Degree of Fineness of the Alloy.	Multiples of Lead.
1000 to 950	4
950 „ 900	6
900 „ 850	8
800 „ 750	12
750 „ 650	14
600 „ 0	16 to 17

The alloy is hammered out and cut into fine shreds. If the sample is in the form of a bar, pieces are taken from the upper and under side at opposite ends.

The weighed lead (granulated or stick lead) is placed in well-ignited cupels standing in the centre of a strongly heated muffle. The muffle is now closed and the fire urged until the lead begins to 'drive.' At first the molten lead will have a dark colour; but this will soon disappear, and the lead will exhibit a brilliant fuming surface. The muffle is now left open except for a piece of glowing charcoal placed across its mouth. If the temperature of the muffle be properly adjusted, the fumes of lead will rise with a whirling motion. If they rise straight up, the temperature is too high, and the cupels must be cooled by moving a cooling-iron backwards and forwards over them. This appliance consists of a rectangular piece of iron 2″ long by 1·6″ broad by 0·3″ thick, fixed to a handle about 2 feet long; it should be frequently cooled in water. If the temperature be too low the fumes will not rise at all, but will creep over the edges of the cupel. At the proper temperature the lead will be sufficiently fluid to show convection currents, and the beads and patches of litharge formed will be thrown off from the convex surface of the lead from the centre outwards. When this takes place the lead is said to 'drive.' A further indication of a correct temperature is furnished by the appearance of the litharge. A rim of this in the form of fine scales should be seen on the inner part of the cupels next to the lead, the cupels themselves glowing with a dark brown colour. This crystalline litharge is known as plumose litharge (*Federglätte*). There should also be a bright but not too wide border of litharge upon the lead. If the temperature sinks too low the cupels become too dark, the rim of litharge covers the whole cupel, and the lead ceases to 'drive.' The assay is then said to 'freeze.' It is not of much use bringing the assay up to the 'driving' point again by increasing the temperature and adding more lead, as a loss of silver is almost sure to take place. If the temperature be too high the cupels will glow too brightly, and neither the plumose litharge on the cupel nor the rim of litharge on the lead will be visible, and loss of silver will ensue from volatilisation and absorption by the cupel.

When once the right temperature has been reached and the lead is driving properly, the fire should be urged no longer. The alloy is now added to the lead, and the ignited piece of charcoal replaced at the mouth of the muffle. The oxidation of the lead is now allowed to go on until nearly all of it is removed; this stage is indicated by the patches of litharge on the lead

becoming larger. When this is the case the use of the cooling-iron is discontinued, and the fire is urged until the last traces of lead have been removed. The disappearance of these is marked by the surface of the lead assuming a play of rainbow colours, an effect due to 'interference,' and produced by the extremely thin film of litharge which covers the metallic bead. Finally this disappears, and the operation is at an end. The cupels should not be removed at once, as there is danger of losing silver through 'spitting' see SILVER), but they should be gradually drawn towards the mouth of the muffle. When cool they are removed, and the buttons detached and cleaned with a brush. If the assay has been successful, the surface of the button will be smooth, and will have a silver lustre on the upper and a dull silver-white colour on the under side. If the temperature has been too low the upper surface will be dull, and will have a bluish tint, whilst the under surface will be covered with a yellowish or greenish coating of lead oxide. If too high the button will be very bright in some places, dull in others, surface sunken, and very liable to have suffered loss from spitting. It will possess rootlets, and will adhere strongly to the cupel, and its under side will be porous. The buttons are now weighed, and if the samples have been taken from the upper and lower sides of a bar, the average, or, more generally, the lowest percentage is chosen as representing the average composition of the metal. To this must be added the approximate loss of silver from absorption by the cupel. The following, taken from 'The Assayer's Manual,' by Bruno Kerl (edited by Wahl), will give an idea of its amount:

"Bars with over 980-thousandths of silver show no difference if the work has been carefully done. With 980—725-thousandths they show a difference of ½—3 thousandths; with 720—710, again no difference; with 400—200-thousandths the greatest difference occurs. Very considerable differences may occur if the bars or buttons have been badly fused. The silver button contains about 2-thousandths of lead. The following table gives the allowances usually made for loss with silver of different degrees of fineness."

"*Correction Table for the Absorption by the Cupel, determined by the French Commission on Coinage and Medals.*

True Quantity of Silver.	Loss to be added (Thousandths)	True Quantity of Silver.	Loss to be added (Thousandths)
1000	1·03	675	4·73
975	1·76	650	4·71
950	2·50	625	4·70
925	3·25	600	4·68
900	4·00	575	4·68
875	4·07	550	4·68
850	4·15	525	4·68
825	4·22	500	4·68
800	4·30	475	4·50
775	4·41	450	4·31
750	4·52	425	4·13
725	4·64	400	3·95
700	4·75	375	3·61
350	3·27	175	2·12
325	2·94	150	1·70
300	2·60	125	1·29
275	2·58	100	0·88
250	2·56	75	0·66
225	2·55	50	0·44
200	2·53	25	0·22"

The following is the composition of the more important coins:

The German reichsmark, German thaler, Austrian and South German gulden, 900-thousandths of silver; English silver coins, 925; French small silver coins, 825; 5, 2, 1, ½, ¼ franc pieces, 900; German nickel coins, Cu 75%, and Ni 25%; German copper coins, Cu 96%, Sn 3%, Zn 1%; French small copper coins (5 cent.), Cu 95·21%, Sn 3·18%, Zn 0·44%, Ni 0·25%, Pb 0·58%, Ag 0·06%; Swiss coin (5 cent.), Cu 58·920%, Zn 23·700, Ni 11·561, Ag 5·146, Pb 0·326, Co 0·286 (Kerl's 'Assayer's Manual').

The lead used for the above assay is known as 'assay lead.' It is prepared in a granulated condition by rocking pure lead, heated until it forms a thick liquid paste, in a trough well coated with chalk. The granulated lead is then sifted. Pure 'Pattison' lead in the form of sticks is also made for the assay of gold and silver. If pure 'assay' or 'Pattison' lead cannot be obtained, ordinary lead should be granulated as described above, and the percentage of silver determined in 30 or 40 grms. of it by means of the scorification assay (see LEAD). When using this lead, the amount of silver contained in the quantity taken must of course be deducted from the weight of the button.

GOLD ASSAY. The first operations in the assay of gold are similar to those in the assay of silver, the alloy being cupelled with lead and the compound button of gold and silver weighed. It is next necessary to separate the gold from the silver. This is done by boiling the gold-silver alloy with nitric acid, when the silver dissolves, and the residual gold—after washing and drying—is ready to be weighed. In practice, however, it is found that the separation by nitric acid only gives accurate results when the ratio of gold to silver is 1 to 2½ or 3; hence the name 'quartation' given to this operation. If the proportion of silver is less than the above, great difficulty will be experienced in removing the whole of it. If greater, it is easily dissolved, but the residual gold is very tender and apt to fall to powder, a risk of loss being thereby incurred. Thus it is again necessary here to get some preliminary information as to the approximate amount of gold and silver present in the alloy. This preliminary determination is effected as follows:

1. *The Alloy is Free from Copper.* In this case the colour of the alloy will give a very fair indication of the amount of gold present, and consequently of the amount of pure silver to be added. An alloy of a deep yellow colour will re-

quire $2\frac{1}{2}$ to 3 times its weight of silver; one light yellow, twice its weight; and one of a white colour, an equal weight of quartation silver. A more accurate idea of the quantity of silver present may be obtained by preparing small silver-gold sample buttons, 2 to 3 mm. (0·079 to 0·12 in.) in diameter, containing $\frac{10}{10}$, $\frac{9}{10}$, $\frac{8}{10}$, $\frac{7}{10}$, $\frac{6}{10}$, and $\frac{5}{10}$ of gold. These are placed in a box, and surrounded first with a black ring and then with a white one. The assay button is breathed on and then compared with the sample button. If more than 56% of silver is present, the yellow colour of the gold is entirely masked. 2% of silver imparts to gold a brass colour, 50% a light yellow colour, and 56% a white colour (Kerl's 'Assayer's Manual'). The quantity of silver to be added, so that the ratio of gold to silver may be 1 to $2\frac{1}{2}$ or 3, can now be easily calculated.

2. *The Alloy contains Copper.* In this case a preliminary assay is necessary.

(*a*) *Preliminary Assay with addition of Lead only.* 250 mgrm. of the alloy are weighed out and assayed with 16 to 32 times this weight of lead, according to the probable richness of the alloy in copper. The assay is conducted in the same way as for silver, except that the lead must 'drive' hotter, so that no plumose litharge (*Federglätte*) may appear. The percentage of copper is determined from the difference in weight of the sample before and after assay. The button is then breathed upon, and the amount of silver present determined from its colour as before; the amount of quartation silver which will be required for the principal assay, so that the assay button may contain gold and silver in the ratio of 1 to $2\frac{1}{2}$ or 3, is thus arrived at.

The amount of lead to be used for removing the copper will depend upon the amount of gold present. The lead required will be greater than for cupriferous silver, since gold retains copper more tenaciously than silver does. (Maximum amount of lead for cupriferous gold = 32 times its weight; maximum amount of lead for cupriferous silver = 16—20 times its weight.) The following tables, from Kerl's 'Assayer's Manual,' show the amount of lead to be used:

TABLE I (*for Cupriferous Silver-Gold Alloys*).

If the Gold in 1000 Parts amounts to	Equivalent to Gold.	Multiples of Lead.
1000	24-carat	8
980 to 920	$23\frac{1}{2}$ to 22	12
920 „ 875	22 „ 21	16
875 „ 750	21 „ 18	20
750 „ 600	18 „ 14	24
600 „ 350	14 „ 8	28
350 „ 0	8 „ 0	32

TABLE II (*when the percentage of Gold is very small*).

If the Silver in 1000 Parts amounts to	Equivalent to Silver.	Multiples of Lead.
1000 to 950	15 loth 9 grän	4
950 „ 900	14 „ 9 „	6
900 „ 850	13 „ 9 „	8
850 „ 750	12 „	12
750 „ 650	11 „	14
650 „ 0	10 „ and less	16

(*b*) *Preliminary Assay with addition of Lead and Silver.* This is to avoid a determination of the approximate amount of gold by the colour. 250 mgrm. (3·85 gr.) of the alloy are weighed out and cupelled with 3 times this weight of silver and 16 to 32 times the weight of lead. The amount of copper in the alloy is determined from the difference in weight between the sample taken together with the added silver and the resulting button. The latter is next rolled into leaf, boiled once in a parting-flask with nitric acid of 1·19 sp. gr., and washed and dried in the usual way (see *below*). The weight of the residual gold together with that of the quartation silver added, deducted from the weight of the assay button, gives the percentage of silver in the original sample. From this the amount of quartation silver to be added for the principal assay can be found. It must be such that the ratio of gold to silver in the assay button may be 1 to $2\frac{1}{2}$ or 3.

(*c*) *Preliminary Assay by the Touchstone.* The approximate amount of gold in silver-gold alloys, with or without copper, can be determined by this means, but the process requires more experience (see *below*).

Principal Assay. Two samples of the alloy, previously laminated or granulated and cut into shreds, and each weighing 250 mgrm. (3·85 gr.), are taken. They should be weighed to within 0·1 mgrm. (0·1015 gr.). If the alloy is in the form of a bar, the samples should be taken from the upper and lower sides at opposite extremities, as in the case of silver. The quantity of quartation silver, as determined by the preliminary assay, is next weighed out, cut into shreds, and added to the sample, the whole being wrapped up in a paper cornet. The necessary amount of lead is next weighed out and placed in a cupel standing towards the back of a well-heated muffle furnace. The muffle is now closed until the lead 'drives,' when the sample is added and the muffle again closed, the operation being conducted as for silver, with this exception, that a higher temperature is employed towards the end, so that no plumose litharge shall remain. (If fine gold with 990-thousandths 'drives' too hot or too cold, the resulting button will be 1-1000th too heavy, this being due probably to retained lead which cannot be completely removed by nitric acid. Hence, when fine gold is assayed, it is usual to cupel at the same time a sample of pure gold, equal amounts of lead being used in both cases. Any gain in weight of the pure gold is then deducted from the percentage of gold found for the sample under assay (Kerl's 'Assayer's Manual').

The button, when cold, is removed and cleaned with a brush; it is then hammered into an oval leaf, or it may be passed between steel rollers. In either of these operations the metal should be frequently annealed by placing it in a cupel in the furnace. The edges should also be hammered before rolling, to prevent the leaf from cracking. The oval leaf should be about an inch long by half an inch broad. It is next rolled into the form of a cylinder by wrapping it round a piece of glass tubing, and is then introduced into a 'parting' flask. This consists of a small well-annealed flask with a long narrow neck. It should measure 40 to 50 mm. (1·57 to 1·97 inches) at its widest part, with a neck 15 to 20 mm.. (0·59 to 0·79 inches) wide and 150 to 180 mm

(5·9 to 7·07 inches) long. The roll is covered with pure nitric acid of 1·2 sp. gr. (about 10 grms. of acid should be used), so that the body of the flask is about half full. The acid should be free from nitrous acid, sulphuric acid, and chlorine (for the preparation of the pure acid see NITRIC ACID). The acid in the flask is heated to boiling and maintained in ebullition so long as nitrous fumes are given off; the solution of silver nitrate is then carefully decanted, and a second quantity of acid, this time of 1·3 sp. gr. and previously heated to boiling, is added, and the whole boiled for ten minutes. This solution is again decanted off, a third quantity of acid added, and the boiling repeated as before (if the gold is below 950-thousandths, this third boiling may be omitted). The flasks may be heated on a sand-bath, care being taken that no bumping goes on. After the last acid is poured off, the flask is filled about two-thirds full with hot distilled water, by pouring the latter slowly down the sides of the neck and rotating the flask at the same time. This water is then poured out, and the operation repeated twice. The flask is now filled quite full of water, a glazed porcelain crucible placed on the top, and the whole slowly inverted. By this means the roll of desilverised gold is brought into the crucible, after which the flask is carefully drawn away over the edge of the latter, care being taken that the water does not rush out and carry away the gold. The water in the crucible is next poured off, and the crucible and its contents dried by being placed on a shelf in front of the muffle. The roll of gold has now a brownish matt colour, and is porous. It is next annealed by heating the crucible to whiteness in the muffle-furnace, when it will acquire the usual colour and lustre of gold. It must be weighed as soon as it is cold, as it gradually gains in weight when exposed to the air. When two samples are taken from the upper and lower ends of a bar, the average of the two is reported.

Composition of Coins. German, French, and American gold coins contain 900 parts gold and 100 parts copper. Austrian ducats contain 986-thousandths of gold, Prussian Friedrichsd'or 902, English sovereigns 916, Hanoverian, Brunswick, and Danish pistoles 896-thousandths of gold.

Pure gold is prepared by dissolving ducat gold, or gold which has been cupelled with lead, in cold aqua regia (2 parts HCl to 1 part HNO_3 by volume), the acid being added gradually, so that there may be no excess when all the metal is dissolved. The solution is set aside for several days to allow the silver chloride to agglomerate, and is then filtered. It is next diluted and again filtered, if necessary, after some days. The liquid is now largely diluted, and a freshly prepared solution of ferrous sulphate added so long as a precipitate comes down, after which it is set aside in a warm place until the supernatant liquid is clear. The latter is siphoned off, the residual gold digested with dilute hydrochloric acid, and washed, dried, and fused in a clean clay crucible with borax and saltpetre (Kerl's 'Assayer's Manual').

Pure silver for quartation is prepared by dissolving cupriferous silver in nitric acid, filtering if necessary, diluting largely, and adding excess of hydrochloric acid. The precipitated silver chloride is allowed to settle, the supernatant liquid siphoned off, and the residue washed several times by decantation. It is next digested two or three times with dilute hydrochloric acid, care being taken to wash the precipitate between each digestion. Finally, 3 parts of the well-washed moist precipitate are mixed with $2\frac{1}{2}$ parts of anhydrous sodium carbonate (Na_2CO_3) and $\frac{1}{4}$ part saltpetre, dried over the water-bath, and heated to whiteness in a porcelain crucible.

Examination with the Touchstone. This operation consists in making a streak or mark with the alloy under examination on a rough surface of black basalt or porcelain, and comparing it with that obtained from rods or needles made from alloys of known composition. Five sets of needles are generally used, viz. (1) the red series, consisting of alloys of gold and copper, the proportion of gold increasing by half-carats in successive needles; (2) the white series, consisting of alloys of gold and silver, the gold likewise increasing by half-carats; (3) a mixed series, in which the quantities of copper and silver are equal, the gold increasing as before; (4) a series in which the silver is to copper as 2 : 1, the gold increasing by half-carats; and (5) another in which the silver is to copper as 1 : 2, the gold increasing as before. Needles of the same composition as the legal standards are also often kept.

Besides comparing the colour of the respective streaks, the effect of acids is also frequently made use of. For this purpose the streaks are moistened with a drop (1) of pure nitric acid, (2) of a test acid composed of 98 parts of pure nitric acid, of 1·34 sp. gr. (37° Beaumé), 2 parts of pure hydrochloric acid, of 1·173 sp. gr. (21° Beaumé), and 25 parts of distilled water. Pure nitric acid has practically no effect on streaks from alloys of 15 or 16 carats fine or over. The test acid has no effect on gold of 18 carats fine or over, provided the stone be not hotter than 12° C. The acids are left on for some time and then wiped off. If the streak is unaffected, it will not be removed by this. Assaying by the touchstone requires considerable experience and a very quick eye for colour. The needles are also difficult to prepare. In examining jewellery the outer surface should be removed before the streak is taken, as the outer metal is generally much harder than the inner, is sometimes coloured by boiling with metallic salts, or has a fictitious purity produced in it by boiling with acids.

ASSIMILA'TION. [Eng., Fr.] *Syn.* ASSIMILA'TIO, L.; ANEIGNUNG, VERÄHNLICHUNG, &c., Ger. In *physiology*, the conversion of food into nutriment, and finally into the substances which compose the bodies of animals and plants. The term assimilation, though well understood by physiologists, is somewhat difficult to define. Although it is hardly possible to distinguish sharply between assimilation and nutrition, the two terms are not altogether synonymous; there can be no nutrition without assimilation, but it is conceivable that food should be assimilated without nourishing—that is to say, that in some of the many stages through which it has to pass the food should be turned aside from its proper course in the body, and wasted without effecting its

purpose. The series of events in order, is digestion, absorption, assimilation, nutrition. There is a very common misuse of the term in certain disorders of nutrition, in which 'failure to assimilate food' is set down as the root of the disease; whereas in many of these cases the functions of digestion and absorption are so imperfect that but little of the food taken ever reaches the condition in which it is fit for assimilation.

ASTACUS FLUVIATILIS. The common crayfish. A fresh-water crustacean having a close general resemblance to the lobster, to which it is very closely allied. Crayfishes occur in shallow streams, more especially in those of calcareous districts. They are intolerant of great heat and much sunshine, and are therefore most active towards evening, sheltering under stones and banks during the day, and on this account are said to frequent streams flowing north and south rather than those having an easterly and westerly direction. In winter they burrow deeply into the mud, sometimes to the depth of nearly a yard. They lie in these burrows, with their great claws or chelæ and feelers protruded, and catch larvæ, water-snails, tadpoles, or frogs, and it is said even water-rats; these latter are probably captured by being held under water till they drown. They are omnivorous feeders, and are even said to make short excursions inland in search of food; further, they are cannibals, and eat the weakly members of the family, especially the females, whose claws are not so large as those of the males. The females may be known by their having broader tails than the males. 5,000,000 to 6,000,000 crayfishes are said to be consumed *annually* in Paris, valued at about £16,000. They have been successfully cultivated artificially.

ASTHEN′IC. *Syn.* ASTHEN′ICUS, L.; ASTHÉNIQUE, DÉBILE, Fr.; SCHWACH, Ger. Wanting strength; weak; debilitated. In *pathology*, an epithet of diseases (ASTHEN′IC DISEASES) accompanied by great and well-marked debility.

ASTHEN′OPY. *Syn.* ASTHENO′PIA, L. In *pathology*, incapacity to keep the eyes fixed on near or small objects for any length of time without confusion of vision. Any condition in which the eye cannot be used for long without fatigue, pain, or other symptoms. The common causes are over-exertion of the eyes, particularly by artificial light, or by a very brilliant one, or during convalescence; congestion of the ocular vessels; debilitating discharges or indulgences; and general nervous debility, however produced. It may be of three kinds:

Muscular asthenopia, which consists in a difficulty in maintaining the convergence of the visual lines, is commonest in myopia, and due to some defect in the muscular apparatus of the eye.

Asthenopia from defective accommodation. The patient cannot read for long, the letters do not move or 'dance,' objects simply become misty, or 'the sight goes' for a time, and the eyes feel tired and hot; severe headache and even vomiting occurs, the result of neglect of these symptoms.

Retinal asthenopia. Due to functional exhaustion of the retina or optic nerve.

The *treatment* may consist of rest to the eyes, and ablution of them in cold water, with other efforts to restore their tone and the general health. The prospect of complete cure, when the cause is not removable, is unfavourable; but even when confirmed the disease is not likely to end in blindness. The use of convex spectacles of very low power will generally be found serviceable. In all cases of defective vision, or pain in the eyes and headache after using them, the patient cannot be too strongly urged to consult a competent ophthalmic surgeon. Untold misery may be caused for the want of a *proper* pair of spectacles, or the continued use of glasses unsuited to meet the requirements of the case. See EYE, SPECTACLES, VISION, &c.

ASTHMA [Eng., Ger., L., Gr.] *Syn.* ASTHME, Fr.; ENGBRÜSTIGKEIT, Ger.

Definition. The term is often applied rather loosely to various forms of difficulty of breathing, and especially that which accompanies ordinary chronic bronchitis and certain forms of heart disease; strictly the term should be confined to a specific affection, characterised by the periodic recurrence of general contraction of the bronchial tubes and the difficulty of breathing which naturally results.

Causes. Asthma may be, and not uncommonly is, inherited. It is about twice as common in males as in females. It may manifest itself at any period of life, from infancy to extreme old age; it most commonly developes during the first ten years of life. The first attack may often be traced to whooping-cough, measles, or bronchitis; but generally no such explanation is to be found. When once the disease is developed, characteristic attacks of difficulty of breathing (asthmatic attacks) may be excited by a number of very various conditions, which are by no means the same for different individuals. Dr Hyde Salter gives a long and interesting list of direct causes, such as the inhalation of smoke, dust, of pungent vapours; the smell of cats, dogs, horses, rabbits, or other animals; the odour of roses, privet, or other flowers; the emanations from new-mown hay and powdered ipecacuanha; the change of weather, the prevalence of certain winds, and fog. One of the most curious exciting causes, and perhaps the most inexplicable, is mere change of locality. Some asthmatic patients cannot tolerate a dry atmosphere, some a moist; some can only live inland, and some only at the seaside; and some are said to be so sensitive that they must walk on one side of a particular street. As a rule, moist climates suit asthmatic patients better than dry, low levels better than high altitudes; and the air of large towns almost invariably suits asthmatics better than that of the open country. Thus, London, Bristol, Birmingham, Liverpool, and Glasgow, though for other diseases eminently unsuitable places, seem to be grateful climates to asthmatical patients. An attack of asthma may be provoked indirectly by many causes; certain articles of food, though by no means the same articles for different persons, dyspepsia, constipation, disease of the brain, and violent emotions will produce attacks.

Symptoms. An attack of asthma generally comes on suddenly, and with little or no warning. Sometimes it is preceded by discomfort and symptoms which the patient learns to recognise as premonitory. Dr Salter mentions a peculiar

troublesome itching under the chin not relieved by scratching as a frequent premonitory symptom. The attacks may come on at any time, but for any given patient is generally about the same hour; the majority of cases occur between two and four in the morning; before noon is the most comfortable time for asthmatic patients. The symptoms are those of intense difficulty of breathing; the patient probably wakes up with the attack more or less fully developed; he generally rises from his bed, or, at at all events, sits up and behaves like a person dreading impending suffocation, the sense of which is terrible. The breathing is rather slower than usual, but violent; the mouth open, the nostrils dilated, the shoulders raised, the head thrown back, the whole body placed in a constrained position, such as will enable any and every muscle to be brought into play in the effort to breathe. If the attack come on in the street the patient will hang on to any railings or similar support, and fix the shoulders so that the pectoral and other extraordinary muscles of respiration can be fully brought into play. Patients also frequently rush to an open window with the idea of getting fresh air. There is an expression of intense anxiety on the face, the eyes protrude, the skin may be pale or livid, and there is copious sweating. The paroxysm may last from a few minutes to two or three days; prolonged attacks are generally made up of a series of shorter ones, with tolerably perfect remissions. They subside gradually, and a cough supervenes which is at first dry; but afterwards mucus is expectorated in small quantities.

Continual recurrence of the disease gives rise to a characteristic expression of countenance and a peculiar deformity of the chest which is characteristic, being dilated above and compressed below. The patients are thin, the cheeks furrowed, the shoulders high, the body bent forward, and the head thrown back. Continual attacks and the consequent strain upon the circulation through the lung react upon the heart and cause hypertrophy of the right side, which results in a permanent shortness of breath. The symptoms of chronic bronchitis are also frequently present.

There seems to be but little doubt that asthma is due to spasmodic contractions of the muscular coats of the bronchial tubes, which is probably due to some affection of that part of the brain which governs these muscular fibres.

Treatment. Remove all clothing—collars, neckties, stays, tight jackets, waist-bands, and the like—which can by any possibility hamper respiration. Any gastric or intestinal irritation should be attended to, and the cause if possible removed. Amongst useful drugs may be mentioned emetic doses of ipecacuanha and tartar emetic; the smoking of tobacco or cigarettes made of stramonium; *Lobelia inflata* in large and frequent doses so as to cause great depression; inhalations of *Datura stramonium* or *Datura tatulà*; belladonna, conium, hyoscyamus, and in some cases opium, alcohol, ether, strong coffee; nitre paper burnt in the room. The effects of chloroform are wonderful, but, unfortunately, generally only temporary. With regard to chloroform in asthma it is necessary to utter a word of warning. The relief obtained is such as to tempt asthmatic patients to use it constantly, with the result that unfortunately only too often they take what is for their enfeebled constitutions a fatal dose. Chloroform should, therefore, *under no circumstances* be self-administered. From what has been said regarding the varying effects of climate upon asthma, it is impossible to give any general directions for the treatment of asthmatic patients by change of climate. Some authorities are of opinion that a sort of doctrine of contraries is the only guide—that is to say, if the patients have acquired the disease in a moist climate, a dry one should be tried for its relief, and *vice versâ*. No general rule, however, can be laid down, and a serious case of asthma must be regarded as a constant source of anxiety, for even when a climate has been found in which the patient remains absolutely free from attack even for a considerable time, it must be remembered that climate is not the only predisposing cause, and that, even when all has been done that can be done to avoid the interference of other causes, the climate which gave relief at first may, after a time, cease to do so. Then all that can be done is to try once more the effect of change. See CIGARS, DATURA, STRAMONIUM, CLIMATE, RESPIRATION.

Treatment in Animals. See BROKEN WIND.

Asthma, Grind'ers'. See MELANOSIS.

ASTHMA CURE (Dr Aubrée, Ferte Vidame, Eure et Loire, France). Decoction of senega (10 parts of the root), 250 parts; iodide of potassium, 50 parts; extract of opium, 4 parts; simple syrup, 500 parts; weak spirit, 200 parts. Coloured with some cochineal tincture (*Hager*).

According to a later analysis by Schröppel, this remedy is thus composed:—Iodide of potassium, 9 parts; French lactucarium, 1 part; water, 288 parts; simple syrup, 48 parts; chloric ether, 1½ parts.

ASTHMA TEA (Dr Orleïn). Recommended for difficulty of breathing, dry coughs, loss of sleep, loss of appetite, &c. Liquorice, 8 parts; marsh-mallow root, 6 parts; Iceland moss, 5 parts; a sort of buckbean, 2 parts; horehound, 2 parts (*Schädler* and *Selle*).

ASTHMATIC PASTILLES (S. Kittel's, now Daniel White and Co., New York). Set fire to the pastilles and inhale the smoke. An analysis found in 100 parts:—Nitrate of potash, 20·1 parts; impure resin of scammony, 3·5 parts; gum and sugar, 35 parts; charcoal, plant-stems, and leaves, 40·7 parts (*Dr Fleck*).

ASTIGMATISM. A defect in the eye caused by irregular curvature of the cornea, in consequence of which the rays of light cannot be focussed on one point.

If two very fine lines of equal thickness be drawn on white paper so as to intersect each other at right angles, it will be found that, in order to see the horizontal line quite sharply, the paper must be brought slightly nearer to the eye than when we focus in the vertical line. Absolute freedom from this defect is very rare, and those persons who suffer from it in any considerable degree should at once seek the advice of a competent oculist in order to have a proper pair of spectacles constructed to correct it, otherwise the strain on the eyes caused by the unconscious

attempt to overcome it will produce trouble which may be serious and difficult to cure.

Astigmatism is a common defect of photographic lenses, and in choosing a lens for any purpose, especially for architectural work, the image should be carefully examined for this defect. It can generally be got rid of by the use of diaphragms, but the available aperture of the lens is in this way greatly diminished.

ASTRIN′GENT (-trĭnje′-). [Eng., Fr.] *Syn.* ASTRIN′GENS, L.; ZUSAMMENZIEHEND, Ger. That straitens or causes wrinkling or constriction. In *pharmacology*, an epithet of substances or agents (ASTRIN′GENTS; ASTRINGEN′TIA, L.) which constrict animal fibre and coagulate albuminous fluids, and thereby obviate relaxation and check excessive secretion or discharges. In modern use the word, both as an adj. and subst., is chiefly applied to internal remedies, those of a like character, employed externally, being usually termed 'styptics,' 'desiccants,' &c.

The principal astringents are—alcohol, alum, chalybeates (generally), sulphate of copper, sulphate and perchloride of iron, acetate and diacetate of lead, lime, bichloride of mercury, nitrate of silver, vegetable astringents (see *below*), acetate, carbonate, chloride, oxide, and sulphate of zinc, &c. See DESICCANTS, STYPTICS, TONICS, &c.

Astringents, Min′eral. See ASTRINGENT (*above*).

Astringents, Veg′etable. Of these the principal are—alkanet, bistort, catechu, the cinchona barks and their alkaloids, dragon's-blood, French or red rose, galls, kino, logwood, mastiche, oak-bark, red sanders-wood, rhatany, tormentil, tannic acid, gallic acid, and areca nut (see *above*).

Astringent Prin′ciple. A term formerly restricted to tannin, but now commonly applied to the astringent matter of any vegetable.

ATEES (*Aconitum heterophyllum*). The root of this plant is tonic and antiperiodic, is said to contain no aconitia, and to be of great value in convalescence after debilitating diseases, as well as intermittent and other paroxysmal fevers ('Pharm. Ind.').

Preparation. The powdered root.

Doses. As a tonic, 5 to 10 gr. three times a day; as an antiperiodic, 20 to 30 gr. every three or four hours, irrespective of the presence of pyrexia. See ACONITE.

ATHALIA SPINARUM, Fabricius. THE TURNIP SAW-FLY. Of all the evils to which root crops are heirs, the turnip saw-fly, or rather the grub of the turnip saw-fly, is the greatest. The saw-fly itself is a harmless insect, like almost all the flies, butterflies, and moths, whose grubs and caterpillars desolate cultivated crops. This insect was known in England in the last century, and a marvellous attack of it upon turnips in Norfolk in 1782 is recorded by Mr Marshall ('The Rural Economy of Norfolk,' 1789), who wrote that they came over the sea, and were seen to arrive in clouds so as to darken the air. The leaves of the turnip plants swarmed with grubs, which soon stripped the plants bare. He calculated that many thousands of acres of turnips were destroyed by it in Norfolk in that year. Between the years 1833 and 1838 very much injury was caused by the grubs of this insect in various parts of England and Scotland, as Curtis relates in his 'Farm Insects.' Since then, at various times and in various places, they have been very active, but during the last four years their attacks have been only occasional. The seasons have, perhaps, not been hot enough, for these saw-flies rejoice in heat and dryness. In 1878 turnip-fields near Salisbury were visited by 'ugly black caterpillars,' as a correspondent styled them, which "cleared off five acres of swede plants in no time." In this same year black grubs designated as 'niggers' were seen in a piece of forward rape in Mid Kent. They cleared the leaves off with remarkable rapidity, and it is noteworthy that swede and turnips on the same farm were not infested, nor were other plants in the neighbourhood. They swarmed upon the leaves, which they riddled completely.

In 1882 there were some complaints of injuries sustained through this insect, but these were not very frequent. The worst instance was near Marlborough, in a large field of white Tankard turnips, whose leafage was literally devoured in patches by the grubs described as 'palmers' by the farmer who sent specimens.

A close observer, who has written some charming letters upon insects ('The Letters of Rusticus'), thus speaks of a visitation of the turnip saw-fly:—"The land was everywhere as bare as on the day it had been sowed. There was no speck of green for the eye to rest on. It was a wild and universal desolation; and the black crawling vermin that had caused the ruin were clustered in bunches on the ground, or lingering about the skeletons of the turnip-leaves. No plagues of Egypt could have been more effective. The mischief was complete." Curtis calls this turnip saw-fly 'this angel of darkness,' and says that "the attacks of the turnip-fly are sufficiently vexatious; but the effects of the black caterpillar are infinitely worse, because the crop is destroyed after all the labour and expense attending its cultivation have been bestowed upon it, and generally at a period so advanced that it is in vain to attempt to repair the loss by diligence or industry" ('Farm Insects,' by John Curtis, 1860, p. 38).

Curtis believed with Mr Marshall that the saw-flies came over in swarms from the north of Europe, but added that they are probably bred in small numbers annually in England (op. cit., p. 59). This opinion is not confirmed by recent entomologists, and is hardly worthy of the usually profound sagacity of John Curtis.

Miss Ormerod remarks, in 'The Manual of Injurious Insects,' that "the mischief caused by these flies is simply overwhelming when they occur in large numbers." Professor Westwood states that the larva of this saw-fly has periodically, in this country, proved itself to be one of the most obnoxious of our insect enemies.

The *Athalia spinarum* is well known in Germany, France, Sweden, and other Continental countries. Nördlinger speaks of it as having been most destructive in 1842, in Swabia, and in 1853 especially injurious to turnips and rape in Würtemberg. The summer of this year was very hot, which, Nördlinger adds, favours the increase of these insects ('Die kleinen Feinde der Landwirthschaft,' von Dr Nördlinger, p. 410).

Dahlbom, in his elaborate treatise 'Hymenopterologia Scandinavica,' says that it is generally common in Europe, and that it has caused much harm to plants of the *Brassica* tribe in Sweden, which it devoured down to the roots.

It does not appear to be known in America.

Life-History. The turnip saw-fly, *Athalia spinarum,* is a species of the Order HYMENOPTERA, of the family *Tenthredinidæ,* and of the genus *Athalia* ('The Introduction to the Modern Classification of Insects,' by J. O. Westwood, F.L.S.). The male fly is not so large as the female. They are both of a light orange colour, or like that of the yolk of an egg, the female being of a rather brighter hue than the male. The crown of the head is black. Its four wings are iridescent and much reticulated. It has six feet, which are, as Dahlbom says, *pro ratione corporis robusti.* In length the female is between three and three and a half lines, rather more than the fourth of an inch, and its wing expanse is about three quarters of an inch. At the end of the abdomen of the female is a beautifully contrived piece of mechanism in the shape of a saw for making incisions in leaves for egg deposition. Reaumur describes these instruments of the *mouche à scie* as like the artificial saws of sawyers. Dahlbom, however, holds that the natural saws of the *Tenthredinidæ* are far more complex and more beautifully made. Artificers' saws, whether double or triple, are propelled and withdrawn at once, while the double-bladed saws of the saw-fly are propelled and withdrawn alternately ('Prodromus Hymenopterologiæ Scandinaviæ,' auctore Dr Gustaf Dahlbom, p. 33). With this delicate arrangement of saws the *Athalia spinarum* makes incisions in the leaves of plants whose juices are grateful to its larvæ, and on these places its eggs singly in each slit, and fastens them to the spot with a sticky substance. Curtis thinks this is to keep the cuticles from collapsing so as to injure the egg. The egg is of a light colour and oblong in shape, and is hatched in from five to seven days according to the weather. A single female will lay as many as 300 eggs.

The larva or grub begins to feed at once upon the leaf. It is, when full grown, nearly three parts of an inch long, slaty black in colour, with a pale stripe on either side of the body, having 22 feet and 12 segments besides the head. It moults two or three times, remaining in the larval or grub stage about 20 days. The time depends in a great degree upon the weather. If it is wet and cold the larval period is shortened. In fine hot weather, which is most congenial to them, they remain in this state fully three weeks. Miss Ormerod remarks that they greatly enjoy the full heat of the sun. Before the grubs change they fall off the leaves and wriggle into the earth, and clothe themselves with silken cocoons, to which particles of earth adhere, making a snug case. In the course of from 18 to 21 days in the summer generations the flies come from these cocoons and lay eggs again upon the plants, from which grubs emerge and commence a new series of spoliation, going down into the earth at the end of their term, in which they pass the winter enwrapped in the dirt-covered cases. From these the flies come towards the end of May, and begin the series *de novo.*

Prevention. When turnips, swedes, or rape have been attacked by the saw-fly, it is quite certain that the grubs are in the earth, after the 12th of August. After the crop, or what has been left of it, has been pulled or fed off, the soil should be deeply ploughed, in order to bury the cocoons as far down as possible. If wheat is put in after the turnips the ground should be pressed or 'cart-wheeled,' in order to make it firm, and rolled early in the spring in order to prevent the flies from coming from the cocoons.

Should the crop be fed off late, and oats or barley sown afterwards, the ploughs must be set deeply, for the cocoons are just below the surface, and if they are not turned over with a deep furrow, will be drawn to the surface by the harrows or drags, and change into flies which will be carried by their wings or the breezes to the nearest turnip-fields.

Remedies. Soot applied when the dew is on the plants, or when they are wet from rain, is a useful remedy. Lime and sulphur also make an efficacious dressing. It is a good practice to brush off the grubs by means of bunches of birch, or furze, or green broom, fixed to the horse hoes, so as to take the rows of leafage on either side. Another horse hoe without the side appendages should follow at once to kill or to bury the fallen 'niggers,' as these after their first moult cannot let themselves up and down by means of silken cords, but are compelled to crawl up, and this is a work of difficulty and of time.

In one instance of a bad onslaught of these grubs, a number of men were sent with good thick rods of birch to brush the insects from the leaves. Each man took a drill, and it was astonishing how quickly the ground was got over, and how effectual was the cure. It should be stated that three horse hoes followed immediately in the wake of the gang of brushers, going up and back again between each row of plants.

A large farmer in Kent tried washing the turnip-leaves with a wash of 7 lbs. of soft soap and 8 lbs. of quassia to 100 galls. of water, with good results. He used the hop-washing engines for this purpose, having had them set upon higher wheels, so that the machine might travel down above each row, or drill, of plants. Hop-washing engines, it may be observed, are merely large garden engines with a strong pump within them to force liquid sharply through lengths of flexible hose, with jets, or nozzles (for washing insect-affected plants the Americans have many apparatus, and a whole armoury of jets, nozzles, hose, and pipes; but they have nothing more practical than the hop-washing machine), of various forms, directed by men upon the leaves infested with insects. In performing this operation the men should be instructed to keep the jets well under the leaves, and the horse hoe should follow after the washing.

Washing in this manner for the niggers would be considered too costly, but in a very bad attack it would save the crop, and probably prevent another in the year following in neighbouring fields ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

ATHEROSPERMA. See AMBER-TREE.

ATLAS. In *anatomy,* the first cervical vertebra,

so called because it supports the skull on the spinal column. Comparable figuratively to the manner in which the Atlas of mythology bore the world on his shoulders.

ATMOM'ETER. *Syn.* Atmidom'eter; Atmom'etrum, &c., L.; Atmomètre, &c., Fr. In *chemistry* and *meteorology,* an instrument for measuring the rate of evaporation from a humid surface. It is of very simple construction, and possesses some practical value. It consists of a long glass graduated tube divided into inches, to the bottom of which is attached a hollow ball made of porous earthenware, similar to that used in water bottles. When the instrument is used, water is poured in at the top until it rises to the zero point of the scale. The outside of the porous ball being always covered with dew, the more rapidly the evaporation takes place, the more quickly will the water fall in the tube.

AT'MOSPHERE (-fēre). *Syn.* Atmosphe''ra, L.; Atmosphère, Fr.; Atmosphäre, Luftkreis, Ger. Primarily, a 'vapoursphere;' appr., the mass of respirable gas and aëriform vapours which surrounds the earth; fig., any surrounding medium or influence.

Comp., Chem. prop., Pur., Uses, &c. See Air (Atmospheric).

Mechanial properties of the atmosphere:

Colour:—The prevailing colour of the atmosphere is blue; at considerable elevations this blue tint is lost, and the sky appears deep black. It has been shown by Lord Rayleigh that the blue colour is due to the scattering of the light by small particles of different substances held in suspension, especially in the lower strata of the atmosphere. At higher altitudes the smaller number of these particles causes the sky to appear almost black. The red colours seen at sunset are explained by the fact that when the sun is low its light has to pass through a thicker stratum of air to reach the observer, and consequently the more refrangible or blue rays are absorbed, and the light reflected from clouds appears red.

Density:—The density of the atmosphere diminishes with the distance from the earth's surface, and this is the duplicate ratio of the altitude. Thus, if at a given altitude the density of the air is only one half what it is at the level of the sea, at twice that elevation it possesses only one fourth that density. On this fact depends the application of the barometer to the determination of the elevation or depression of any point above or below the level of the sea, taken as a standard.

Density of the Atmosphere at Different Elevations. By Prof. Graham.

Height above the Level of the Sea in miles.	Volume of Air.	Height of the Barometer.
0·	1	30
2·705	2	15
5·41	4	7·5
8·115	8	3·75
10·82	16	1·875
13·525	32	·9375
16·23	64	·46875

Height, &c.:—If the density of the air were uniform throughout its whole extent, the height of the atmosphere, measured by a corresponding column of mercury, would be barely $5\frac{1}{4}$ miles. As, however, its density decreases with the distance from the earth's surface, its real height must be considerably greater. Kepler found that the reflection and refraction of the sun's rays by the atmosphere, producing twilight, ceases when that luminary descends 18 degrees below the horizon, whence it is calculated that the atmosphere cannot have a greater altitude than 45 miles. On the other hand, there is reason to believe that it cannot be much less than this sum. "With a good air-pump air may be rarefied 300 times; supposing this to be the utmost limit to which rarefaction can be carried, the atmosphere would still extend to an altitude of above 40 miles." Whether, in a state of extreme tenuity in which its grosser properties are lost, it extends indefinitely into space, was formerly a subject of controversy. That its boundaries are limited, and that it belongs exclusively to our earth, appears almost certain. "We are warranted in concluding that the atoms of air are not infinitely divisible, and consequently that the atmosphere has a limit; and the limit must be situated at that height above the earth where the gravitation of the atoms is just equal to the force of their repulsion" (Brande's 'Dict. of Lit., Sci., and Art'). Under ordinary circumstances the mercury of the barometer falls about one inch for every 1000 feet of elevation.

Pressure:—The weight or pressure of the atmosphere is shown by the rise of water in the barrel of the common 'lifting pump,' and the suspension of the mercurial column in the tube of the barometer. The last affords a ready means of determining the actual pressure of the air, the column of mercury, and the column of air by which it is suspended, resembling two weights in equilibrio at the opposite extremities of the same balance.

The mean height of the barometer at the level of the sea, in England, is 28·6 inches (=about $33\frac{1}{2}$ feet of water); and as a cubic inch of mercury weighs 3425·92 gr., or ·48956 *lb.*, it follows that the weight of a column of mercury whose base is a square inch is 14·6 *lbs.* avoirdupois.

The pressure of the atmosphere is not merely downwards, but is equally diffused in all directions, and exerts a most powerful effect in the economy of organic beings. On the surface of the body of an adult of ordinary size = (say 15 sq. feet, or 2160 inches) it amounts to the enormous weight of 31,536 *lbs.*, which is not sensible, only because it is balanced by the force of the elastic fluids in the interior of the body. Were this equilibrium to be suddenly destroyed, the consequence would be, either that the body would be instantly torn to pieces with explosive violence, or that it would be crushed under the overwhelming weight that would suddenly fall upon it. Even the comparatively slight variations of atmospheric pressure which occur with changes of wind, weather, and season, exercise a perceptible effect on the functions of life.

Mean Pressure of the Atmosphere at the Level of the Sea, in different latitudes, at 32° F., expressed in inches of mercury.

Lat.	Height (inches).	Lat.	Height (inches).	Lat.	Height (inches).
0°	29·930	40°	30·019	54½°	29·926
10	29·975	45	30·000	60	29·803
20	30·064	49	29·978	64	29·606
30	30·108	51½	29·551	67	29·673

TEMPERATURE:—The temperature of the atmosphere, independently of changes arising from variations of latitude and season, and disturbances from winds, diminishes, like its density, with its elevation. In general, every 100 yards of ascent causes the temperature to fall 1° Fahr. See AIR, BAROMETER, CLIMATE, CLOUD, DEW, GAS, HYGROMETER, METEOROLOGY, VENTILATION.

Atmosphere. In *engineering* and *pneumatics*, the pressure of a column of mercury at 0° C. or 32° F., which is 76 centimetres or 29·9218 inches high, at the mean level of the sea in latitude 45°, is frequently taken as a standard of that exerted by other elastic fluids. In practice this is assumed to be 15 *lbs.* to the square inch, under a barometrical pressure of 30 inches. Thus, steam or air condensed so as to exert a pressure of 30 *lbs.* per sq. inch is said to be of two atmospheres; of 45 *lbs.*, of three atmospheres, &c.

ATOM and ATOMIC WEIGHT. *Syn.* ATOMUS, L.; ATOME, Fr.; ATOM, UNTHEILBARE THEILCHEN, Ger. The smallest portion of matter which can enter into a chemical compound. [In order to follow this article the more clearly, the reader is requested to refer to the following others in connection with it, in the order named: (1) SYMBOLS and FORMULÆ; (2) ATOMIC VOLUME; (3) MOLECULES and MOLECULAR WEIGHTS AND VOLUMES; (4) QUANTIVALENCE AND VALENCY; (5) EQUIVALENT WEIGHTS AND VOLUMES.]

The ancient Greek philosopher, Democritus, who lived in the 5th century B.C., and after him Epicurus and Lucretius, imagined matter to be made up of the smallest possible indivisible particles—of atoms. This, however, has nothing to do with our present chemical atomic theory, which was first given out to the world by John Dalton in 1803; a detailed account of it will be found in the article on 'Atomic and Molecular Weights,' by Mr Pattison Muir, in Watt's 'Dictionary of Chemistry,' 2nd ed., vol. i, and also in the historical introduction to Roscoe and Schorlemmer's 'Chemistry,' vol. i, both of which have been freely consulted in the writing of this.

"The cardinal point upon which Dalton's atomic theory rests, and in which it differs from all other previous suggestions, is that it is a *quantitative* theory respecting the constitution of matter, whereas all others are simply *qualitative* views. . . . . . Dalton at once declared that the atoms of the elements are not of the same weight; and that *the relative atomic weights of the elements are the proportions by weight in which the elements combine*. . . . . . In 1803 and 1804 Dalton was occupied with the examination of the composition of the two gaseous hydrocarbons, marsh gas and olefiant gas, and the results of his examination led him to the adoption of the atomic theory. He found that both of these bodies consist solely of carbon and hydrogen, and that the first of these gases contains twice as much hydrogen to a given quantity of carbon as the second. Hence he concluded that olefiant gas contains one atom of carbon combined with one of hydrogen, whereas marsh gas consists of one atom of carbon combined with two atoms of hydrogen" (*R.* and *S.*, loc. cit.).

Dalton's 'Atomic Theory' forms the chief basis of modern chemistry; the work which he inaugurated was continued by Gay-Lussac, Avogadro, Berzelius, and other chemists and physicists of great eminence.

The methods by which the relative weights of the atoms of the different elements—*i. e.* the *atomic weights* of these—are arrived at are both varied and complex, and any attempted description of them would be entirely out of place here. But a few words may be added with respect to the proportions in which one element unites with another.

1. *Law of Constant Proportion.* Let us take any element, say chlorine, and analyse quantitatively a few of its compounds, *e. g.* the chlorides of hydrogen, sodium, potassium, and silver; we shall then find that in every one of these cases 35·4 parts by weight of chlorine have combined severally with 1 part by weight of hydrogen, 23 of sodium, 39 of potassium, and 108 of silver. Again, if we analyse any of the compounds of sodium, we find that in every case 23 parts by weight of that element (or some simple multiple of this number) have entered into combination with *chemically* equivalent proportions by weight of other elements; we never find either more or less than the 23 parts by weight (or its multiple). And the same holds good for every other element. It is thus evident that *elements combine with one another in fixed and definite proportions by weight;* and the number which indicates this fixed proportion is known as the *combining* or *atomic weight* of the element.

2. *Law of Combination in Multiple Proportions.* At the time when the law of constant proportion was still under discussion, it was found by Dalton that when two or more elements combine together to form more than one compound, the proportions by weight in which they are present are either those of their combining weights or some simple multiples of these. Thus we know a whole series of compounds of nitrogen and oxygen in which these are present in the proportions:

Parts by weight of Nitrogen.		Parts by weight of Oxygen
(1) $14 \times 2 = 28$	. . .	to 16
(2) $14 \times 2 = 28$	. . .	„ $16 \times 2 = 32$
(3) $14 \times 2 = 28$	. . .	„ $16 \times 3 = 48$
(4) $14 \times 2 = 28$	. . .	„ $16 \times 4 = 64$
(5) $14 \times 2 = 28$	. . .	„ $16 \times 5 = 80$

On the other hand, there are *no* compounds known in which nitrogen and oxygen are present in proportions other than those of 14 : 16, or some simple multiples of these numbers. The above series of compounds illustrates what is known as the *law of combination in multiple*

proportions, which is so intimately connected with the *law of constant proportion.*

Hydrogen, the lightest substance known, is always taken as the standard element to which the atomic (and molecular) weights of all other elements (and compounds) are referred, and the atomic weight of hydrogen is therefore taken as 1. That of nitrogen is 14, of oxygen 16, and so on; in other words, the atoms of hydrogen, nitrogen, and oxygen have the relative weights: 1, 14, and 16. The *molecule* of any element or compound must consist of at least two atoms. See MOLECULE and MOLECULAR WEIGHTS AND VOLUMES.

Appended below is a table giving the atomic weights of the elements (taken from 'Watt's Dictionary,' 2nd ed.), the names of the more commonly occurring ones being printed in large type, and those of the rarer ones in small.

Name.	Symbol.	Atomic Weight.
Aluminium	Al	27·02
Antimony	Sb	120
Arsenic	As	74·9
Barium	Ba	136·8
Beryllium	Be	9·08
Bismuth	Bi	208
Boron	B	10·9
Bromine	Br	79·75
Cadmium	Cd	112
Cæsium	Cs	132·7
Calcium	Ca	39·9
Carbon	C	11·97
Chlorine	Cl	35·37
Cerium	Ce	139·9
Chromium	Cr	52·4
Cobalt	Co	59 (?)
Copper	Cu	63·2
Didymium	Di	144
Erbium	Er	166 (?)
Fluorine	F	19·1
Gallium	Ga	69
Germanium	Ge	72·32
Gold	Au	197
Hydrogen	H	1
Indium	In	112
Iodine	I	126·53
Iridium	Ir	192·5
Iron	Fe	55·9
Lanthanum	La	139·9
Lead	Pb	206·4
Lithium	Li	7·01
Magnesium	Mg	24
Manganese	Mn	55
Mercury	Hg	199·8
Molybdenum	Mo	95·8
Nickel	Ni	58·6 (?)
Niobium	Nb	94
Nitrogen	N	14·01
Osmium	Os	193
Oxygen	O	15·96
Palladium	Pd	106·2
Phosphorus	P	30·96
Platinum	Pt	194·3
Potassium	K	39·04
Rhodium	Rh	104
Rubidium	Rb	85·2 (?)
Ruthenium	Ru	104·4
Scandium	Sc	44 (?)
Selenium	Se	78·8
Silver	Ag	107·66
Silicon	Si	28·3
Sodium	Na	23
Strontium	Sr	87·2
Sulphur	S	31·98
Tantalum	Ta	182
Tellurium	Te	125
Thallium	Tl	203·64
Thorium	Th	231·87
Tin	Sn	117·8
Titanium	Ti	48
Tungsten	Wo	183·6
Uranium	U	240
Vanadium	V	51·2
Ytterbium	Yb	173 (?)
Yttrium	Yt	93·0 (?)
Zinc	Zn	64·9
Zirconium	Zr	90

ATOMIC VOLUME. "The atomic volume of a body is the space occupied by a quantity of it proportional to its atomic weight, and is therefore expressed by the quotient of the atomic weight divided by the weight of a unit volume, *i. e.* by the specific gravity:

$$\textit{Atomic volume} = \frac{\textit{atomic weight}}{\textit{specific gravity}}.$$

It must not, however, be supposed that the atomic volumes represent the relative volumes of actual material atoms of different bodies" (Watt's 'Dictionary of Chemistry,' 1st ed., vol. i).

ATOMIC WEIGHTS. See ATOM.

ATONIC. *Syn.* ATON'ICUS, L.; ATONIQUE, Fr.; ATONISCH, SCHLAFF, Ger. Weak; debilitated; deficient in tone or strength. In *pathology,* applied to diseases or conditions of the body (ATONIC DISEASES; ATONY) in which debility is the leading feature. In *pharmacology,* ATONICS are agents which relax or lower the tone of the system.

ATONY. *Syn.* ATO'NIA, L.; ATONIE, &c., Fr., Ger. In *pathology,* loss of tone, relaxation, morbid diminution of vital energy or power; commonly applied to debility of any kind.

ATROPHY (-fe). *Syn.* ATRO'PHIA, L.; ATROPHIÉ, &c., Fr.; ATROPHIE, Ger. In *pathology,* wasting or emaciation, with loss of strength, and unaccompanied by fever or other sensible cause; defective nutrition; decline.

Classif., Causes, &c. It is either local, as in the case of a limb which is small, imperfectly or irregularly developed, or withered; or general, affecting the whole body. GEN'ERAL ATROPHY appears to depend on deficient nutrition, arising from some defect of the functions of absorption and assimilation, or from profuse evacuations draining off the materials necessary for the support of the body, as in tuberculous intestinal disease. In the former case only may it be re-

garded as an independent disease. LO'CAL ATROPHY commonly arises from some cause which lessens the normal circulation of blood in the part; or from a diminution of the nervous influence, as in paralysis. General atrophy is most frequent in infancy, childhood, and old age. In the first two it may be often traced to bad nursing, worms, or a scrofulous taint; and not unfrequently to continually inhaling impure or damp air. Those who live in damp and dark rooms or cellar dwellings often manifest symptoms of atrophy; the bad and insufficient food obtained by such persons is probably an important factor in its causation. In adults, the causes are impaired digestion and imperfect absorption, and sometimes disease of the liver.

Treatm. This consists in a close attention to diet (which should be liberal and nutritious), exercise, clothing, ventilation, warmth, &c., with gentle stimulants, and chalybeate tonics where not contra-indicated; and, in the case of adults, the moderate use of pure generous wine or malt liquor. Among special remedies, both in this disease and anæmia, may be mentioned pure sweet cod-liver oil, which seldom fails to arrest or greatly retard the progress of the disease, and in very many cases effect an entire cure. When this affection is symptomatic of any other disease, as worms, stomach or liver complaints, &c., the removal of the latter must of course be first attempted. See ANÆMIA, CHLOROSIS, TABES, &c.

ATRO''PIA (-trōpe'y'ă). $C_{17}H_{23}NO_3$. [L.; B. P.] *Syn.* AT'ROPINE (-pin; sometimes atro'pīne‡), Eng., Fr.; ATROPI'NA, ATRO''-PIUM*, L. An alkaloid discovered by Brandes in *At'ropa bella-don'na*, or deadly nightshade.

Prep. 1. (B. P. process.) Take of belladonna root, recently dried, and in coarse powder, 2 *lbs.*; rectified spirit, 10 *pints*; slacked lime, 1 *oz.*; diluted sulphuric acid, carbonate of potash, of each a sufficiency; chloroform, 3 *fl. oz.*; purified animal charcoal, a sufficiency; distilled water, 10 *fl. oz.* Macerate the root in 4 pints of the spirit for 24 hours, with frequent stirring. Transfer to a displacement apparatus, and exhaust the root with the remainder of the spirit by slow percolation. Add the lime to the tincture placed in a bottle, and shake them occasionally several times. Filter; add the diluted sulphuric acid in very feeble excess to the filtrate, and filter again. Distil off three fourths of the spirit, add to the residue the distilled water, evaporate at a gentle heat, but as rapidly as possible, until the liquor is reduced to one third of its volume and no longer smells of alcohol; then let it cool. Add very cautiously, with constant stirring, a solution of carbonate of potash so as nearly to neutralise the acid, care, however, being taken that an excess is not used. Set to rest for six hours, then filter, and add carbonate of potash in such quantity that the liquid shall acquire a decided alkaline reaction. Place in a bottle with the chloroform; mix well by frequently repeated brisk agitation, and pour the mixed liquids into a funnel furnished with a glass stopcock. When the chloroform has subsided, draw it off by the stopcock, and distil it on a water-bath from a retort connected with a condenser. Dissolve the residue in warm rectified spirit; digest the solution with a little animal charcoal; filter, evaporate, and cool until colourless crystals are obtained.

2. Expressed juice of belladonna is evaporated over a water-bath to the consistence of an extract, and then triturated in a marble or porcelain mortar with a solution of caustic potash; the resulting mass is digested and well agitated for some time at the temperature of 75°—80° F., with benzole q. s.; and, after repose, the benzole solution is carefully separated, and its volatile hydrocarbon is distilled off by the heat of a water-bath; the residuum in the retort is now exhausted with water acidulated with sulphuric acid, and the resulting 'acid-solution,' after filtration, precipitated with carbonate of sodium; the precipitate is crude ATROPIA, which is collected on a filter, pressed between folds of bibulous paper, and dried; after which it is purified by one or more re-solutions, in alcohol, and crystallisations, which may or may not be modified in the manner noticed. The proportion of potassa should be about 1 dr. to every quart of the expressed juice. An excellent and economical process.

3. (*Mein* and *Liebig.*) Belladonna root (fresh-dried and coarsely powdered) is exhausted by alcohol (sp. gr. 0·822); slaked lime (1 part for every 24 of the dried root employed) is then added to the tincture, and the whole digested, with agitation, for 24 hours; sulphuric acid is next added, drop by drop, to slight excess, and, after filtration, rather more than one half the spirit is removed by distillation; a little water is now added to the residue, and the remainder of the alcohol evaporated as quickly as possible by a gentle heat; after again filtering, the liquid is reduced by further evaporation to the $\frac{1}{12}$th part of the weight of the root employed, and a concentrated solution of potassa dropped into the cold liquid (to throw down a dark greyish-brown matter), carefully avoiding excess or rendering the liquid in the slightest degree alkaline; in a few hours the liquid is again filtered, and carbonate of potassium added as long as a precipitate (ATROPIA) falls; after a further interval of from 12 to 24 hours, this precipitate is collected and drained in a filter, and after pressure between folds of blotting paper, dried by a very gentle heat. It is purified by making it into a paste with water, again squeezing it between the folds of blotting-paper, drying it, re-dissolving it in 5 times its weight of alcohol, decolouring it with pure animal charcoal, distilling off greater part of the alcohol, and evaporation and crystallisation by a very gentle heat; or only about one half the spirit is distilled off, and 3 or 4 times its volume of water gradually agitated with it, the resulting milky liquid being then heated to boiling, and allowed to cool very slowly, when nearly the whole of the ATROPIA crystallises out after a few hours. The same may be effected by at once agitating 6 to 8 volumes of water with the alcoholic solution, and setting aside the mixture for 12 to 24 hours, by which time the crystallisation will be completed. This process originated with Soubeiran, was improved by Mein, and subsequently, with slight modifications, adopted by Liebig. The product is about 0·3% of the weight of root operated on.

4. (*Bouchardat* and *Cooper.*) The filtered tincture is precipitated with iodine dissolved in an aqueous solution of iodide of potassium, the resulting ioduretted hydriodate or atropia, decomposed by zinc and water, the metallic oxide separated by means of carbonate of potassium, and the alkaloid thus obtained dissolved in alcohol and crystallised.

5. (*Rabourdin.*) To the crystallised juice of the plant (previously heated to coagulate its albumen, filtered, and allowed to cool), 1 quart, is added of caustic potash 1 dr., and afterwards of chloroform 1 oz.; the whole is then agitated well, and after half an hour's repose, the supernatant liquor is poured from the discoloured chloroform, which, after being washed with distilled water as long as it gives any colour to that liquid, is placed in a small retort, and the chloroform distilled off by the heat of a water-bath; the residuum is dissolved in a little water acidulated with sulphuric acid, and precipitated with carbonate of potassium, in slight excess; the precipitate is redissolved in alcohol, and the solution, by spontaneous evaporation, yields crystals of ATROPIA.

6. (*Ure.*) From the expressed juice of the fresh, or the watery extract of the dry plant, by treating it with caustic soda, in slight excess, and then agitating the mixture with $1\frac{1}{2}$ times its volume of ether; the ATROPIA taken up by the ether is again deposited after repose for some time, and is purified by repeating the treatment with fresh ether as often as necessary.

7. Freshly precipitated hydrate of magnesia is added to the coagulated and filtered expressed juice, and the mixture evaporated to dryness, as quickly as possible, in a water-bath; the residuum is pulverised and digested in strong alcohol, and the clear liquid allowed to evaporate spontaneously. The crystals may be purified by repeated re-solutions in alcohol.

8. (*Dunstan* and *Ransom.*) Twenty grammes of the dried and finely powdered leaves are well packed in an extraction apparatus, and exhausted with about 100 c.c. of absolute alcohol. The alcoholic liquid is diluted with about an equal volume of water made slightly acid with hydrochloric acid. The chlorophyll, fat, &c., are then removed from the slightly warmed liquid by repeatedly extracting it with chloroform until nothing further is removed by the solvent. The aqueous liquid is made alkaline with ammonia and the alkaloids extracted by chloroform, by evaporating which a residue of pure alkaloid is obtained, and dried by heating it at 100° until a constant weight is attained. A specimen of dried foreign leaves contained 0·22% of total alkaloid, and a specimen of English leaves which had been somewhat overheated in drying contained 0·15%. But the authors believe that both specimens contain less alkaloid than English leaves which have been carefully grown and gathered.

Prop., Tests, &c. Commercial atropine is a mixture in varying quantities of atropine and hyoscyamine. The crystals obtained from hot concentrated solutions are colourless, transparent, silky prisms; from solutions in dilute spirit, silky needles, like those of sulphate of quinine. It is colourless; has a bitter, acrid, and somewhat metallic taste; dissolves in 200 parts (300 parts—*Thomson*) of cold and 50 to 54 parts of boiling water, in $1\frac{1}{2}$ parts of cold alcohol, and in 25 parts of cold, and 6 parts of boiling ether; it has an alkaline reaction, fuses at about 112° C., is slightly volatile at common temperatures, and freely rises in vapour at 212° F.; at higher temperatures it volatilises with partial decomposition; with the acids it forms salts, of which several are crystallisable.

Tests. 1. Nitric acid forms with it a yellow solution:—2. With cold sulphuric acid it gives a colourless solution, which becomes red only when heated:—3. Aqueous solutions of atropia and its salts are—*a*, turned red by tincture of iodine—*b*, gives a citron-yellow precipitate with terchloride of gold—*c*, a flocculent whitish precipitate with tincture of galls, and—*d*, a yellowish-white one with bichloride of platinum:—4. Heated with caustic potassa or soda, it suffers decomposition, and ammonia is evolved:—5. A weak solution cautiously applied to the eyelid or conjunctiva, produces dilation of the pupil lasting for several hours.

Gerrard has shown that when solutions of pure atropine and a mercuric salt are mixed, the mercury is partly thrown out as mercuric oxide. Professor Flückiger has confirmed this ('Pharm. Journ.,' January 16, 1886), but states that mercurous salts do not give a parallel reaction. Mr Gerrard, replying to Flückiger, in the 'Pharm. Journ.' of March 6, shows that both soluble and insoluble mercurous salts are reduced by atropine. Calomel when slightly heated in an aqueous solution of atropine becomes almost black, and the reaction is aided greatly by the presence of 20% of alcohol. Similarly with mercurous nitrate. The reaction is one of double decomposition, and may be taken advantage of for detection of atropine. For this purpose ·3% mercurous nitrate solution, and 1% atropine solution (alcohol 1, water 4); 1 c.c. of each should be used in a test-tube.

The researches of Ladenburg have shed much light on the constitution of atropine, and the allied alkaloids, daturine, hyoscyamine, and duboisine. He says "heavy daturine and atropine are identical." "Light daturine and light atropine are identical with hyoscyamine." "Duboisine is nearly pure hyoscine, but also contains hyoscyamine." "When heated with baryta water atropine splits into tropine and tropic acid." For further information see 'Year-book of Pharmacy,' 1883.

Pur., &c. Alkaloid prepared from the root of *Atropa belladonna.* Crystals; white, in the form of prisms; soluble in water and rectified spirit. It leaves no ash when burned with free access of air (B. P.).

Phys. Eff. It is a very powerful narcotico-acrid poison (a 'cerebro-spinal poison'—*Taylor*). Its effects are similar to those of belladonna, but considerably more powerful. "A very minute (imponderable) quantity applied to the eye is sufficient to dilate the pupil" (*Pereira*). The $\frac{1}{12}$ to $\frac{1}{10}$ gr. often causes very serious effects in the human subject. The 1-6th of a grain accelerates the pulse, affects the brain, causes dryness of the throat, difficulty of deglutition, dilation of the pupil, dimness of sight, giddiness, strangury,

numbness of limbs, sense of formication in the arms, rigidity of thighs, depression of pulse, and sometimes feebleness or loss of voice. These symptoms continue for from 12 to 24 hours. In larger doses death ensues.

Ant., &c. These may be similar to those described under BELLADONNA and ALKALOID.

Uses. Chiefly as an external agent, as a substitute for belladonna, to cause dilation of the pupil; and as a local anæsthetic or anodyne, especially in facial neuralgia. Internally, it has been occasionally given in hooping-cough, chorea, and a few other nervous diseases, also to check the night sweats in phthisis.—*Dose,* $\frac{1}{30}$ gr. gradually increased to $\frac{1}{20}$, or, occasionally, even $\frac{1}{16}$ gr. in solution, or made into a pill with liquorice powder and honey, or syrup, or used endermically; for a collyrium, 1 gr. to water 1 oz., a few drops only being applied to the eye at a time, the greatest caution in each case being observed. It is also employed to make the sulphate, and other atropine salts. In dispensing it a single drop of acetic acid, or dilute sulphuric acid will be found to facilitate and ensure its perfect solution. See BELLADONNA and BELLADONINE.

Atropine, Sul'phate of. *Syn.* ATROPINÆ SUL'PHAS, L. *Prep.* (B. P.). Take of atropia, 120 *gr.;* distilled water, 4 *fl. dr.;* diluted sulphuric acid, a sufficiency.

Mix the atropia with the water and add the acid gradually, stirring them together until the alkaloid is dissolved and the solution is neutral. Evaporate it to dryness at a temperatnre not exceeding 100°.

Characters and Tests. A colourless powder, soluble in water, forming a solution which is neutral to test-paper, and when applied to the eye dilates the pupil as the solution of atropia does. It leaves no ash when burned with free access of air.

Uses, &c. The same as those of the pure alkaloid.—*Dose,* $\frac{1}{50}$ to $\frac{1}{20}$ gr., either in solution or pills; 1 to 4 gr. to water 1 fl. oz., as a collyrium, of which a few drops seldom fail to produce full dilation of the pupil in about a quarter of an hour; 1 to 2 gr. to lard 1 dr. forms an excellent ointment in neuralgic affections. It is the most commonly used of the atropine salts.

Obs. Sulphate of atropia is rather difficult to crystallise, as it has a tendency to assume an amorphous or gum-like condition. It is more soluble than the pure alkaloid; and, like it, is a poison.

ATROP'IC ACID. *Syn.* ACIDUM ATROP'ICUM, L. The name given by Richter to a volatile crystallisable substance, possessing acid properties, found in *Atropa belladonna,* or deadly nightshade. In many respects it resembles benzoic acid, from which, however, it is distinguished by not precipitating the salts of iron.

ATROPI'NA, At'ropine. See ATROPIA.

ATROPINE VALERIANATE. The Paris Codex directs this salt to be prepared as follows:—Dissolve valerianic acid in ether, and add atropia just sufficient to saturate the acid. Let the ether evaporate.

AT'TAR. Attar of roses is chiefly prepared from flowers grown on the lower slopes of the Balkans. In Roumelia the average annual produce is about 4000 lbs., valued at £60,000. Some attar is also obtained in the south of France, Tunis, and Persia, as well as at Ghazepore, in India. The Turkish attar is almost invariably adulterated with the oil of an Indian grass (*Andropogon,* q. v.). See OTTO and VOLATILE OILS.

ATTELETTES (-lĕts'). [Fr.] In *cookery,* small skewers, generally of silver, with ornamental heads. The term is also applied to small dishes (ENTRÉES, &c.) in which the articles are mounted on attelettes. Small fish, as smelts, are often served in this way. See AIGUILLETTE.

ATTEN'UANT (-ū-ănt). *Syn.* ATTEN'UANS, L.; ATTÉNUANT, Fr.; VERDÜNNEND, Ger. That makes thin, or less dense or viscid; diluting. In *medicine,* applied to remedies (ATTEN'UANTS, SPANÆM'ICS) which are supposed to act by thinning, diluting, or impoverishing the blood.

ATTENUA'TION. *Syn.* ATTENUA'TIO, L.; ATTÉNUATION, Fr.; VERDÜNNUNG, Ger. A thinning or diminishing; a reducing in consistence. In *medicine,* see the adj. (*above*); in *brewing,* the decrease of the density of worts during fermentation, arising from the gradual conversion of their 'saccharine' (sugar) into alcohol. See BREWING, DISTILLATION, WORTS, &c.

ATTRAC'TION. [Eng., Fr.] *Syn.* ATTRAC'TIO, L.; ANZIEHUNG, Ger. The power that draws together matter and resists its separation. Between every two particles of matter there exists a mutual force tending to diminish the distance between them, and this force is called *gravitational attraction.* The attraction between the earth and other bodies which exists in consequence of gravitational attraction is called *gravity.* Gravitational attraction is exerted at all sensible distances, up to—so far as we know—the very greatest, and determines the figure and motions of the planets and comets, and causes the descent of heavy bodies to the ground. This force it is which gives to ordinary matter its weight.

There is probably no real distinction between cohesion and adhesion, but it is usual to define them as follows. That force which unites particles of the same kind of matter, so as to cause them to assume the condition of solid or liquid masses, *e.g.* particles of chalk to form a mass of chalk, particles of water to form a mass of water, is called COHESION, or the ATTRACTION OF COHESION. That force which binds together different substances without changing their properties, as when paint sticks to wood, ink to paper, &c., is called ADHESION, or the ATTRACTION OF ADHESION. CAPILLARY ATTRACTION depends on forces between the particles of the substance which are insensible at sensible distances, and which, therefore, are only made manifest by the phenomena seen at the free surface of a liquid, or at the surface of separation between the liquid and another substance. There is no doubt that the adhesion between two substances is due to the action of the same or similar forces. The absorption of water by a sponge, and the ascent of oil in the wick of a lamp are examples of capillary attraction. CHEMICAL AFFINITY differs from all other kinds of attraction in being exerted between definite and constant quantities (atoms) of matter, usually of dissimilar natures, and pro-

ducing combinations possessing properties different from those of their components. (See AFFINITY.) This force, as well as cohesion and adhesion, is exerted at distances so small as to be immeasurable.

The terms ELEC′TRIC ATTRACTION and MAG-NET′IC ATTRACTION are employed in *physics* to denote forces which exist between electrified bodies and between magnetised bodies.

ATTRI″TION (-trĭsh′-ŭn). [Eng., Fr.] *Syn.* ATTRI″TIO, L.; ABREIBUNG, AUFREIBUNG, Ger. In *mechanics*, the wearing away of parts by friction. In *medicine*, a graze, abrasion, or solution of continuity of the cuticle, or the act which causes it. See ABRASION, FRICTION, &c.

AURA [*αὔρα*, a breeze, Gr.]. In *medicine*, a peculiar sensation, subjective in origin, immediately preceding an epileptic or hysterical convulsion, and called respectively the *Aura epileptica* and *Aura hysterica*. The word was originally adopted because the sensation is often described as that of the passage of cold air or light vapour from the trunk or the extremities to the head.

AURANTIA′CEÆ (-she-ē). [Lat., DC.] The orange tribe. In *botany*, an extensive and important natural order of exogenous trees and shrubs, found exclusively in the temperate and tropical parts of the Old World, and unknown in a wild state in America. The fruit is pulpy, succulent, sub-acid, and eatable, separated into cells by membranous partitions, and covered with a leathery aromatic skin or rind. Some of the genera embrace plants of great beauty and utility. A few of the Indian species are climbers. The genus CIT′RUS, which includes the orange, lemon, citron, lime, bergamot, and shaddock, is that best known in Europe. See ORANGE.

AURAN″TIIN (-she-ĭn). *Syn.* HESPERIDIN; AURAN′TINE* (-tĭn), Eng., Fr.; AURANTII′NA, &c., L. The bitter principle of the peel of oranges and lemons.

Prep. The exterior or yellow peel of the Seville orange (carefully separated from the white matter, and air-dried) is steeped in hot water, and the filtered liquor gently evaporated to dryness.

Prop., &c. It possesses the bitter properties of the peel without any of its glutinosity or fragrance, and is said to agree better with delicate stomachs. It may be taken in water either with or without the addition of a little sugar or capillaire, or dissolved in wine.

AU″RIC (aw′- or awr′-). *Syn.* AURI′CUS, L. Of or relating to gold, or containing it, or formed from it.

AURICLE. The cavity or cavities of the heart which *receive* blood either from the lungs or the general venous system, in contradistinction to the ventricles, which discharge it to the lungs or into the general arterial system. The name is derived from a fancied resemblance to an ear.

AURIF′EROUS. *Syn.* AU″RIFER, AURIF′ERUS, L.; AURIFÈRE, Fr.; GOLDHALTIG, Ger. In *mineralogy*, that which yields or contains gold; as auriferous sand, a. quartz, &c.

AURIPIGMEN′TUM†. [L.] Literally, paint of gold; appr., native orpiment. See ARSENIC, SULPHIDES OF.

AURO-CHLO″RIDES or **CHLOR-AURATES.** Compounds of trichloride of gold with chlorides of other bases. They may be prepared by mixing trichloride of gold with the chloride of the base in question, in atomic proportions, and setting aside the solution to crystallise. As examples of these double salts we may mention potassium chlor-aurate, $KAuCl_4$, and sodium chlor-aurate, $NaAuCl_4 + 2H_2O$.

Prop., &c. Most of the chlor-aurates crystallise in prisms, dissolve in both alcohol and water, have an orange or yellow colour, and are decomposed at a red heat.

AURO-CY′ANIDES or **CYAN-AURATES.** Compounds of cyanide of gold with cyanides of other bases. They may be formed in a manner similar to the auro-chlorides. Auro-cyanide of potassium is much used in electro-gilding.

AURORA BOREALIS. This is a natural phenomenon, the true nature of which is still in a great measure unknown. It consists in a luminous appearance in the sky which manifests itself under divers forms. The most usual is that of a luminous arc on the northern horizon. The lower border of this arc is generally sharper and better defined than the upper one. Below the arc the sky appears blacker than usual. The highest point of the aurora lies approximately in the due magnetic north, *i. e.* north as indicated by the needle. The arch of the aurora is very frequently composed of isolated rays, reaching from the lower to the upper border, and of varying length and intensity. Its position in the sky above the horizon is somewhat variable; sometimes it appears to be partly below the horizon, and sometimes considerably above it. Occasionally there are two or even three bows, one above the other. Now and again the aurora is divided into several separate parts, or, perhaps more correctly, the whole arch is not visible at once, but shows itself by flashes of light which are only visible in one portion of the sky at a time. This, perhaps, is the more common form, but the aurora as seen in the arctic regions frequently presents the appearance of a uniform illumination of the sky. The colour of the aurora is generally white or yellowish; a red aurora is sometimes seen, and other colours have been observed.

As its name implies, the aurora borealis is most frequently seen in the northern regions of the globe, occasionally in the southern, and very rarely in the tropics. In the Southern Hemisphere the corresponding phenomenon is called the aurora australis.

The places in which the aurora borealis is most frequently seen are comprised in a zone of oval form, which includes Hudson's Bay, Labrador, the southern extremity of Greenland, Iceland, Finmark, the Caspian Sea, Northern Siberia, the sea to the north of Behring's Straits, and the most northern part of North America. To the south of this zone the aurora manifests itself generally in the northern part of the sky, and to the north of the same appears in the southern portion. Sometimes the aurora borealis has been observed at the same time over a great part of the Northern Hemisphere; for example, North America, the North Atlantic Ocean, Europe, and a part of Asia. In rare cases it has been observed in low latitudes, *e. g.* in Jamaica and in Bombay, as a feeble glimmer on the northern horizon.

The frequency of the aurora borealis has an annual period; it is greatest at the equinox, and least at the solstice. Besides this there is a period of ten or eleven years in which the frequency of the phenomenon increases or diminishes in proportion to that of the sun spots, consequently the years 1844, 1855, 1866, 1877, &c., are especially poor in auroral displays.

Lastly, there appears to be another period of about sixty years in which the aurora is particularly frequent and brilliant. Thus the years 1728, 1780, and 1842 were marked by peculiarly frequent and magnificent displays. It is to be noted that these two latter periods were remarkable for exceptional terrestrial magnetic phenomena.

As to the height of the aurora above the earth, the opinions of experts are divided. From a number of independent determinations many auroræ have been placed at a height of more than twenty geographical miles above the earth. At this altitude the atmosphere is extraordinarily rarefied. Some authorities are of opinion that at all events in high latitudes the aurora occurs in the lowest strata of the atmosphere. The aurora borealis seems to exert a decided influence on the state of the lower strata of the atmosphere; and during a brilliant aurora, and especially when its 'corona' appears, the sky clouds over and clears again with extraordinary rapidity. The relations between the aurora and the great movements of the atmosphere have not been accurately determined. In the case of those magnificent displays which appear to fill the sky with flickering light, on the authority of observers whose trustworthiness can hardly be called in question, a certain rustling noise is heard comparable to that of a silk dress. Since the strata in which the aurora is believed to be placed are so rarefied as to be incapable of transmitting sound, this noise can only be attributed to something occurring on the earth, which acts upon the lower strata of the atmosphere, whilst in the higher regions it produces a luminous effect. That is to say, assuming the existence of this sound, the aurora must be regarded rather as a terrestrial than as a celestial phenomenon.

Our knowledge of the form and position of the aurora in space is very limited, but from what is known it may, perhaps, be regarded as a ring of light almost parallel to the zone in which auroræ are most frequent. This ring is formed of rays of light, which, in their direction, coincide approximately with that of the lines of terrestrial magnetic force in that part of the earth in which the display occurs. Frequently, however, the aurora consists of a mere luminous appearance without regular form, and it will be obvious also that according to the laws of perspective the portion seen and the form of it will vary very considerably with the position of the observer. If the observer is placed exactly under a part of the ring of the aurora, then the rays visible to him have for the most part the same direction as the local lines of magnetic force, appearing parallel overhead and meeting in some point in the heavens, which point will be precisely indicated by the inclination of the magnetic needle. What is the precise cause of the aurora, in spite of much investigation, is still unknown, but the fact that during auroral displays magnetic instruments are disturbed more or less in proportion to the intensity of these displays, must lead us to the conclusion that there is a very intimate relation between the conditions which govern terrestrial magnetism and those which result in the phenomena of the aurora.

AURORA POMADE. For promoting the action of the skin. Cocoa butter with orris.

AUSCULTATION. A method of physical examination by listening at various points on the surface of the body, either by direct application of the ear to the part or by the use of an instrument, the stethoscope. The method is more especially used in investigating the state of the heart and lungs.

AUTOCTHONOUS. Generated on the spot. Used of diseases which are distinctly confined to certain localities or areas, and are apparently generated from the soil of these localities Applied especially to malaria.

AUTOG′ENOUS (tŏj′-). *Syn.* AUTOGE″NEAL; AUTOG′ENUS (tŏj′-), L. Self-generating or affecting; acting without the aid of foreign matter. In *anatomy*, &c., developed from distinct and independent centres; as parts or processes. Among *metallists*, it denotes a method of joining metals by fusing the parts in contact by means of a flame of hydrogen, or of a mixture of hydrogen and common air, without the intervention of a fusible alloy or solder. Lead, and even ordinary hard solders, are, however, sometimes so employed, and the name, though improperly, retained.

AUTOGRAPHY. In *lithography*, a term applicable to all kinds of writing upon transfer-paper, but usually restricted to writing upon plain hard-sized writing-paper, with a strong lithographic ink. This process, though yielding fair results, is yet inferior to writing upon transfer-paper, because only part, instead of the whole of the ink, is left upon the stone in transferring.

AUTOMAT′IC. *Syn.* AUTOMATI′CUS, AUTOM′ATUS, L.; AUTOMATIQUE, Fr.; AUTOMATISCHE, Ger. Self-acting or self-moving, or that seems to be so; mechanical; of or resembling an automaton. In *physiology*, involuntary, applied to functions which are performed without the operation of the will; as the movements in respiration, the contractions and dilations of the heart, the persistent contraction of the sphincters, &c. In *mechanics*, &c., moving and acting from concealed machinery; also, as applied to *machinery*, self-regulating and directing, within the limits prescribed by its author, though moved by external power. To the last class belongs the self-acting machinery of our flax and cotton mills, our engineering establishments, &c.; in which the elemental powers are made to animate, as it were, millions of complex organs, infusing into forms of wood, iron, and brass, an agency resembling that of intelligent beings. The manufactures in which such machinery is employed are termed the AUTOMATIC ARTS.

AUTOPSY. Literally, personal observation or examination; ocular view. The term, however, is now applied, rather loosely, to a post-mortem investigation. A post-mortem may be performed

with the object of endeavouring to ascertain the cause of death in a medico-legal inquiry, or in the furtherance of the study of pathology. It is also a preliminary to embalmment, and is sometimes had recourse to as a means of saving the child when a woman dies in full pregnancy.

In France no post-mortem examination is permitted to take place until at least 24 hours after death, this delay being enforced as a safeguard against the possibility of the body operated upon being still alive. In England no post-mortem can be made without the consent of the friends of the deceased, unless by warrant from a coroner. Whenever, however, a prisoner dies in gaol an inquest and post-mortem are held on the body.

AUTOTYPE PROCESS. See CARBON PRINTING and PHOTOGRAPHY.

AUTUMNAL FEVER. This term is chiefly employed by American medical writers to designate typhoid fever, because of its prevalence in the autumn.

AUXILION. A packet of small plasters for the painless and radical cure of corns. Each plaster is to be worn for about a week, and then the horny pustule is to be removed with a sharp knife. The plaster is a compound of 1 part of resin plaster and 2 parts of lead plaster, and is likely to promote the removal and solution of the thick skin of the corns (*Hager*).

AVA. *Syn.* AWA, KAVA-KAVA. The root of a remarkable plant, *Piper methysticum*, held in renown in all the Polynesian Islands. Those who have visited these remote districts say that the plant in question produces sleep, which is accompanied by visions that are of an enchanting nature. In this respect they consider it more powerful than either opium or Indian hemp. The sale of Awa in the Sandwich Islands is prohibited except on the production of evidence that it has been prescribed by a physician. Nevertheless, no law in these islands is more frequently violated. It grows almost everywhere, springing up spontaneously in all parts of the islands, so that it is quite impracticable to prohibit its culture. The taste of the root is described as being acrid, or as an acid pungent flavour like horse-radish, with a certain aromatic odour.

It is not uncommon to see a couple of girls and an old man or so sitting on the ground masticating awa root, the process being contemplated with interest by a number of adults standing around. When the substance of the root is thus reduced to a pulp they toss it into a large calabash and prepare for a fresh mouthful. This goes on till a considerable quantity of the pulp is provided, then water is added and the mass is kneaded and well stirred with the hands until it has the appearance of soap-suds. It is then strained through a cloth, and after more water has been added the liquid thus prepared is poured into cocoa-nut cups and handed round to the company.

Those who drink this preparation pass through a stage of idiocy into a deep sleep, which, we are assured, can be reproduced once without a further dose by bathing in cold water. Confirmed awa drinkers might be mistaken for lepers, for they are covered with whitish scales, and have inflamed eyes, and a thickened epidermis, which eventually turns white and peels off.

Awa is occasionally taken as a medicine; it is supposed to be a cure for corpulency. The root and base of the stem are the parts used, and preferably when fresh. It has a powerful fascination for the inhabitants of the Polynesian Islands. In the Fiji Islands it is used medicinally for rheumatism, &c., and the natives employ it as a narcotic and stimulant beverage. Awa has, like tobacco, a calming effect rather than an intoxicating influence, unless the juice be fermented as described above.

The root contains an essential oil, some resins, and a crystalline body named *kavain* or *methysticin*.

An alcoholic extract and tincture are sometimes given for treatment of gonorrhœa.—*Dose* of extract 3 to 10 gr., in form of pill.

AV'ENIN (-nĭn). *Syn.* AVENA'INE* (ăv-e-); AVENI'NA, &c., L.; AVÉNINE, &c., Fr. A nitrogenous compound, analogous to, and probably identical with, casein, obtained from oats, and on which its nutritiveness chiefly depends.

Prep. The grain, reduced to the state of powder or meal, is washed on a sieve, and the milky liquid, after being allowed to deposit its starch, is heated to about 200° F., to coagulate the albumen; when cold, acetic acid is added as long as a white powder falls, which is AVENIN; this is collected on a filter, drained, and dried by a gentle heat.

AVEN'TURIN, Avant'urin (-ū-rĭn—Knowles and Smart). [Eng., Fr.] A beautiful iridescent variety of rock crystal, minutely spangled throughout with golden scales of mica (AVENTURIN, A. QUARTZ). A variety of felspar (A. FEL'SPAR) of somewhat similar appearance is found on the Continent, especially in Spain, of which the finer kinds are called A. ORIENTALE and PIERRE DE SOLEIL by the lapidaries. Both varieties are now imitated by glass and porcelain manufacturers; indeed, artificial aventurin glass is even more beautiful than the natural mineral. See GLASS, GLAZE, PASTE, &c.

A'VIARY (-ve-). *Syn.* AVIA''RIUM, L.; VOLIÈRE, Fr.; VOGELHAUS, VOGELHECKE, Ger. A place for keeping birds; generally applied to an enclosed space or building in which birds are kept or bred, on account of their rarity, plumage, or song, and not for food.

Situation, &c. For exotic birds, a place should be selected where the temperature can be maintained at a proper degree throughout the year, and which is well protected from the weather. This is commonly done by choosing a space attached to the summerhouse or hothouse. When the aviary is only intended for birds of climates similar to our own, any part of the open garden may be chosen, and a portion closed in, either with trellis-work or wire-work, or netting; care being taken to provide, in some easily accessible portion of it, full protection from vicissitudes of weather and season. Nor must cleanliness, and due ventilation and protection from foul air or noxious fumes, be left unattended to.

AVIGNON BERRIES (ăv-veen-yo*ng*). French berries.

AVOCADO PEAR. Fruit of *Persea gratissima*,

Gaert. Grown in tropical America, West Indies (where it is much esteemed), and the Atlantic Islands.

AVOIRDUPOIS' (ăv-ĕr-du-poiz'). The common weight of 16 *oz.* or 7000 gr. to the lb., used in these realms for all kinds of goods, except jewelry and the precious metals. Medicines are now dispensed by this weight, as ordered in the 'British Pharmacopœia' of 1867.

AX'IS. [L., Eng., Fr.] *Syn.* AXE, Fr.; ACHSE, Ger. Primarily, that on or around which anything acts or performs; an axle or axle-tree. In *anatomy,* that on or around which any organ or part rests, gravitates, or centres. The second cervical vertebra, so called because of a projecting pin or axis (morphologically the *centrum* of the vertebra above it, the atlas) around which the atlas carrying the head can rotate. In *astronomy,* the diameter on or about which a celestial body revolves. In *botany,* part or parts about which particular organs are arranged; an imaginary line passing from the base to the apex of a pericarp, &c. In *crystallography,* imaginary lines passing through the central points of a crystal, and about which the molecules or particles of matter composing it may be conceived to be symmetrically built up. In *geology,* the centre of a mountain group. In *mechanics,* the straight line, real or imaginary, about which any body oscillates or revolves. See CRYSTAL, &c.

AX'LE, Ax'le-tree (ăks'l). *Syn.* ESSIEU, Fr.; AXE (am rade), &c., Ger. In *mechanics,* the pin, rod, or material line on which a wheel, &c., turns. See FRICTION, &c.

AX'UNGE (-ŭnje). *Syn.* AXUN'GIA, L. *Primarily,* 'wheel-grease;' the lard or fat of an animal; restricted in *pharmacy* to hog's lard.—AXUNGIA CURA'TA, A. PREPARA'TA, is prepared or washed hog's lard (which *see*).

AYER'S PILLS. Sold in long wooden boxes, each containing 25 pills, covered with sugar and starch, and composed of pepper, colocynth, gamboge, and aloes (*Hager*).

AZADIRACHTA INDICA (Ind. Ph.). Nim or Margosa Tree (Ind. Ph.). *Habitat.* Common throughout India; often cultivated in gardens.—*Officinal parts.* 1. The bark (*Azadirachtæ cortex,* Nim bark). It varies much in appearance, according to the size and age of the tree producing it. The bark from the trunk of a tree above three or four years of age is covered with a thick scaly epidermis, and varies in thickness from $\frac{1}{4}$ to $\frac{1}{2}$ inch. That from the smaller branches is smooth, of a dullish purple colour, marked by longitudinal lines of ash-coloured epidermis, from $\frac{1}{8}$ to $\frac{1}{12}$ of an inch apart. The inner layer of the bark, of a whitish colour in the fresh state, is powerfully bitter, far more so than the outer dark-coloured layer, which, however, possesses a greater amount of astringency. It contains a crystallisable principle (margosine) and an astringent principle (catechin). 2. The fresh leaves (*Azadirachtæ folia,* Nim leaves).—*Properties.* Bark astringent, tonic, and antiperiodic; leaves stimulant.—*Therapeutic uses.* In intermittent and other paroxysmal fevers, in general debility, and convalescence after febrile and other diseases, the bark has been employed with success. The leaves form a useful application to ulcers and skin diseases, when a mild stimulant is required. —*Dose.* Of the powdered bark, a drachm three or four times a day.

Preparations. DECOCTION OF NIM BARK (Decoctum Azadirachtæ). Take of the inner layer of nim bark, bruised, 2 *oz.;* water, a pint and a half. Boil for fifteen minutes, and strain whilst hot.—*Dose.* As an antiperiodic, from $1\frac{1}{2}$ to 3 *fl. oz.,* every second hour previous to an expected paroxysm. As a tonic, 1 or 2 *fl. oz.* twice or thrice daily. As this decoction soon decomposes in hot weather, it should be prepared fresh for use when required.

TINCTURE OF NIM BARK (Tinctura Azadirachtæ). Take of the inner layer of nim bark, bruised, $2\frac{1}{2}$ *oz.;* proof spirit, 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient proof spirit to make 1 pint. It may also be prepared by percolation in the same manner as Tincture of Calumba, q. v.—*Dose.* From $\frac{1}{2}$ to 2 *fl. dr.* as a tonic.

POULTICE OF NIM LEAVES (Cataplasma Azadirachtæ). Take of fresh nim leaves a sufficiency; bruise and moisten with tepid water. A good stimulant application to indolent and ill-conditioned ulcers. Should it cause pain and irritation, as it sometimes does, equal parts of rice-flour and linseed-meal may be added. The bitter oil of the seeds is held in high repute by the natives as an anthelmintic, and as an external application in rheumatism. It is also said to be an insecticide.

AZIMUTH. In *astronomy,* the angular distance of an object from the north or south point, or the angle formed with the meridian by a great circle passing through the zenith and the object.

AZO'IC. *Syn.* AZOÖ'TIC; AZO'ICUS, AZOÖT'ICUS, &c., L. Lifeless; wholly destitute of organic life. In *geology,* &c., applied to strata which do not contain organic remains.

AZOLIT'MIN (ăz-o-lĭt'-mĭn). A dark red substance obtained by Kane from litmus, of which it forms a large portion of the colouring matter. It is insoluble in alcohol, and also in water unless the latter is alkalised; it dissolves with a blue colour in ammonia, and forms blue and violet lakes.

AZ'OTE* (ăz'-ōte; a'-zōte). [Eng., Fr.] *Syn.* AZO'TUM*, L.; AZOT*, Ger. Lavoisier's name for nitrogen (because it is unfit for respiration, *i. e.* destroys life).

AZ'OTISED (-tīzd). *Syn.* NITROGENISED. Containing azote or nitrogen; a term commonly employed regarding nitrogenous substances which are used as food.

AZ'URE (ăzh'-ūre; ā'-zhure—Knowles, Smart, Walker). *Syn.* CÆRU'LEUM, L.; AZUR, Fr.; HELLBLAU, HIMMELBLAU, Ger. In *dyeing* and *painting,* sky-blue; also the name of one or more pigments which possess this colour. See BLUE DYES, BLUE PIGMENTS, SMALTS, ULTRAMARINE, &c.

AZ'URE-STONE. Lapis lazuli.

AZ'URITE (-īte). In *mineralogy,* lazulite; blue malachite; sometimes, lapis lazuli (the name being, unfortunately, very loosely applied by different writers).

AZ'YMOUS† (-e-mŭs). *Syn.* AZ'YMUS, L. Unleavened, unfermented; as sea-biscuit. Unleavened bread was formerly termed AZ'YME† (-e-me) and AZ'YMUS† by theologians.

BAB'LAH. The rind or shell of the fruit of *Mimosa cineraria.* According to Dr. Ure, it contains a considerable quantity of gallic acid, some tannin, a red colouring principle, and an azotised substance, and is the article imported from the East Indies and Senegal under the name of NEB-NEB. Used as a cheap dye-stuff for various shades of drab and grey.

BAC'CA (băk'-ă). [L.; pl., bac'cæ, băk'-sē.] A berry.

BACON (bā'-kn). [W., baccun, prob. from Ger., bache, a wild sow; "old Fr. for dried flesh or pork"—*Craig.*] The flesh of swine salted and dried, and subsequently either smoked or not. The term is usually restricted to the sides and belly so prepared; the other parts of the animal having distinctive names. Sometimes, though rarely, the term is extended to the flesh of bears, and of other like animals, cured in a similar manner.

Qual., &c. When bacon has been properly prepared from young and well-fed animals, and is neither 'stale' nor 'rusty,' it forms a very wholesome and excellent article of food, especially adapted for a light or hasty meal, or as a relish for bread or vegetables. For persons with a weak stomach, and for invalids, great care should be taken to cook it without injuring its flavour, or rendering it indigestible. This is best effected by cutting it into slices of moderate thickness, and carefully broiling or toasting it; avoiding dressing it too hastily, too slowly, or too much. The common practice of cooking it in almost wafer-like slices, until it becomes brown and crisp, renders it not merely indigestible, but also a most fertile source of heartburn and dyspepsia. Fried bacon is remarkably strong, and is hence more likely to offend the stomach than when it is broiled, or preferably toasted before the fire; the last being, of all others, the best way of dressing it so as to preserve its delicacy and flavour. Gourmands, however, often esteem, as 'une bonne bouche,' bacon dressed in the flame arising from the dropping of its own fat.

Choice. Good bacon has a thin rind, and an agreeable odour, the fat has a firm consistence and a slightly reddish tinge; the lean is of a pleasing red colour, is tender, and adheres, whilst raw, strongly to the bone. When the fat is yellow, it is either 'rusty' or becoming so, and should be avoided. The streaky parts are not only those which are most esteemed, but are the most wholesome.

Bacon should be broiled or toasted in front of the fire. The rashers should be in thin slices, and the rind should be removed. The melted fat from the bacon should never be wasted. To partake of all broiled meats in perfection they should be served up as soon as they are taken off the gridiron.

The bacon of the shops is of very variable quality, dependent entirely on the method of curing and the food of the pigs. The fat of bacon from American maize-fed pigs is said to contain much more oleïn than English dairy-fed; it has, therefore, a lower melting point, and is much more wasteful in cooking. In purchasing bacon it is the strictest economy to select the best.

BACTERIUM (bacterion = a little rod, Gr.). In recent years, the diligent application of the microscope to the investigation of disease and the elaborate researches which have been made into the nature of the phenomena of fermentation and putrefaction, whilst affording an explanation of many, till recently, but little understood phenomena, has in addition led to a vast increase in our knowledge of the very lowest forms of life and of the important part played by them in the economy of nature, and, above all, their relationship to man as possible producers of disease.

The minute organisms which are now become of such importance and popularly known as microbes, bacteria, bacilli, germs, &c., have now been sufficiently studied to enable us to classify them to a certain extent, and to separate them into groups according to their form, mode of reproduction, and the nature of their life processes.

General Morphology, &c. Bacteria may be considered as minute vegetable cells destitute of nuclei. They are distinguished from animal cells by being able to derive their nitrogen from ammonia compounds, and they differ from the higher vegetable cells in being unable to split up carbonic anhydride into its elements, owing to the absence of chlorophyll.

Chemical Composition. According to Nencki they contain about 83% of water, and 100 parts of the dried constituents has the following composition:

A nitrogenous body	84·20
Fat	6·04
Ash	4·72
Undetermined substances	5·04

The nitrogenous body Nencki called mycoprotein, and found it to consist of carbon 52·32 parts, hydrogen 7·55 parts, nitrogen 14·75 parts, but no sulphur or phosphorus. The constitution of the nitrogenous body appears to be different in different species. The cell wall consists of cellulose and—according to Nencki, in the putrefactive bacteria—of mycoprotein; it may be demonstrated by the action of iodine, which contracts the protoplasmic contents and renders the cell wall visible.

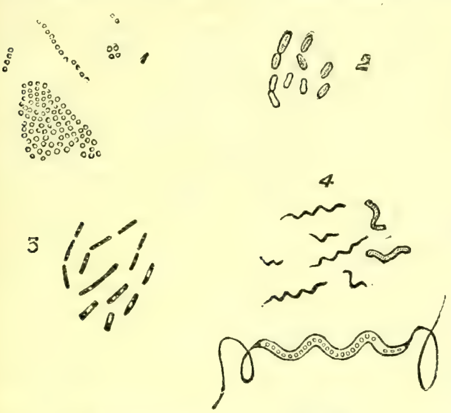
The protoplasm of the cell is in some cases homogeneous, in others granular, and, as far as may be judged from the action of staining fluids upon it, is not of the same constitution in different species. As a general rule those stains which act most readily upon nuclear protoplasm are the best for bacteria, but this is not always the case. In the protoplasm of some forms starch granules are present, in others granules of sulphur. In the pigmented bacteria the coloured particles are, as a rule, between the cells, or at all events outside them, though in one or two species the colouring matter is dissolved in the cell protoplasm.

In several species there is formed, either by secretion from the cell or the swelling up of the outer parts of the cell wall by the absorption of moisture, a sort of gelatinous envelope, forming a matrix in which numbers of bacteria are embedded (zooglœa).

Forms. Bacteria vary very considerably in form, not only of the individual cells, but of the groupings in which they arrange themselves and to which a special terminology has been applied.

The best classification is that given by Cohn:

(1) sphærobacteria or micrococci, (2) bacteria or microbacteria, (3) bacilli or desmobacteria, (4)



1. Micrococcus. 3. Bacillus.
2. Bacterium. 4. Spirillum.

spirilla, (5) spirochætæ. There are many varieties which resemble one or other of these, such as ascococcus, sarcina, leptothrix, cladothrix, streptothrix, &c.

Micrococcus. By this term we are to understand a minute spherical or ovoid organism which multiplies by fission (schizomycetes), possessing no special organs, cilia, &c., giving them the power of independent motion. Micrococci always propagate by fission, never by gemmation or budding, or the formation of spores. Their size varies considerably from about 0·0008 mm. to 0·002 mm. or even more. They all multiply by slightly elongating and then dividing into two by a transverse constriction forming a dumb-bell; each of these divides again into two, either transversely or in the same direction as before, whilst in the state of division they may remain connected together in chains (mycothrix). In other cases the individual elements may become united together by the gelatinous substance before mentioned, forming continuous masses (zooglœa). These various modes of arrangements are more or less characteristic of different species. In some the dumb-bells divide again transversely to form another dumb-bell, producing a group of four (tetrade or sarcina-form). Micrococci are further spoken of as aërobic when they require free oxygen for their development and live upon the surface of the nutrient fluid, and as anaërobic when they do *not* require free oxygen and grow well in the depth of the nourishing material.

They may be divided according to their chemical and physiological function into: (*a*) septic, (*b*) zymogenic, (*c*) chromogenic, and (*d*) pathogenic micrococci.

(A) The *septic micrococci* are micrococci which occur with other septic bacteria wherever there is decomposition of organic matter in solids or fluids. There exists a large number of such micrococci differing from one another in size and mode of growth. They are widely distributed in the air, and contamination by air is often followed by the appearance of micrococci. They also occur in the body of man and animals wherever there is dead tissue, in which they grow well and copiously (*Klein*). The micrococci of pus afford a good example.

(B) *Zymogenic micrococci* are micrococci associated with definite chemical processes. (*a*) *Micrococcus ureæ*, causing the ammoniacal fermentation of urine, occurs singly, as dumb-bells or chains, and as zooglœa. (*b*) The micrococcus of the mucoid wine fermentation produces (*Pasteur*) a peculiar mucoid change in wine and beer, and occurs chiefly in chains. (*c*) The micrococcus causing the phosphorescence in putrid fish and meat (*Pflüger*) forms chiefly zooglœa (äerobic).

(C) *Chromogenic micrococci* (*Schroter, Cohn*). These are characterised by their power of forming pigment of various colours. They grow well at ordinary temperatures and occur chiefly as zooglœa; they differ from one another by forming different pigments. The thicker the layer the more marked is the pigment. The cells are spherical (*Micrococcus prodigiosus; chlorinus; fulvus*) or slightly elliptical (*M. luteus; cyaneus; violaceus; auriantiacus*).

They grow well on boiled potato, bread, paste, and boiled-egg albumen. They can be transplanted and always produce the same pigment. When growing and kept in the depth of a solid nourishing material, they grow as colourless micrococci. They abound in the air (*Klein*).

Ascococcus. A name given by their discoverer, Billroth, to certain spherical, oval, or knobbed masses of minute micrococci, found in putrid meat infusion.

Sarcina ventriculi. A name given by Goodsir to peculiar groups of four cubical cells found in the vomit of some patients. They are of a green or reddish colour, and are found in the stomach of man and the lower animals in health and disease.

(D) *Pathogenic micrococci.* Of these the following are the most important: The micrococcus of pus, *M. variolæ et vacciniæ*, *M. erysipelatosus*, *M. diphtheriticus*, *M. pneumoniæ*, *M. gonorrhœæ*, *M. bombycis*, found in the contents of the alimentary canal of silkworms dead of the 'maladie de morts-blancs, *flacherie*.'

Bacterium. A name given by Cohn to a class of minute schizomycetes, which are slightly elongated and oval or short and cylindrical, with rounded ends. They divide by fission like the micrococci, elongating and becoming constricted in the middle. They are capable of spontaneous locomotion, being possessed of a flagellum at one or both ends with which they can perform active spinning and darting movements.

Oxygen appears to be necessary for the performance of these movements. Bacteria may be found as dumb-bells, as chains if they are in a state of such rapid division that they have not had time to separate, and also as zooglœa.

(A) *Septic bacteria.* *Bacterium termo* may be said to be the essential cause of decomposition, being the true saprogenous ferment (*Cohn*). They are invested with a thick membrane and are flagellate. With the end of putrefaction they disappear. They are almost universally distributed and may readily be found in almost any sample of water. A peculiarity of this organism is that if cultivated on any of the various media

which are used for the purpose, after a period varying from days to weeks, the cultures die, a fact which distinguishes them from all other bacteria.

Bacterium lineola occurs in stagnant water where no distinct putrefaction is going on.

(B) *Zymogenic bacteria.* Two kinds are known; the *Bacterium lactis,* which sets up the lactic-acid fermentation in milk, and *Bacterium aceti* (*Mycoderma aceti*), the organism which causes the acetic-acid fermentation in alcoholic solutions.

(C) *Pigment bacteria. Bacterium xanthinum* produces the yellow colour of yellow milk. *Bacterium æruginosum* is found in green pus.

(D) *Pathogenic.* Of these there are three kinds; the bacterium of Koch's septicæmia, of Davaine's septicæmia, and of fowl-cholera. Any detailed description would be out of place here, but something will be said regarding the last named under POULTRY, DISEASES OF.

BACILLUS (Desmobacterium, *Cohn*).

The following description of the general characters of bacilli is largely taken from Dr E. Klein's book, 'Micro-organisms and Disease.'

Bacilli are cylindrical or rod-shaped bacteria, which are rounded or square cut at their extremities; they are longer in proportion to their thickness than *Bacterium termo,* and divide by fission, forming straight, curved, or zigzag chains of two, four, six, or more elements. Many species of bacilli, in suitable nourishing materials, grow by repeated division into longer or shorter chains of bacillus-filaments or *leptothrix.* These appear straight, or wavy and twisted, isolated or in bundles; and though in fresh condition they appear of a homogeneous aspect, when suitably stained and prepared, as by staining with anilin dyes and by drying, they show themselves composed of shorter or longer cubical, cylindrical, or rod-shaped protoplasmic elements, contained in linear series within the general hyaline sheath; between many of the elements is a fine transverse septum. The isolated bacilli are likewise composed of a membrane and protoplasmic contents. The latter appear homogeneous or finely granular, and when stained with anilin absorb the dye very easily, and retain it better and longer than the membrane. According to the stage and the rapidity of their growth, the bacilli vary much in length; this is the case not only with the single bacilli and short chains, but also in an eminent degree with the elements of a bacillus-filament or leptothrix. In each case indeed it is possible to ascertain that all lengths occur from the cubical or spherical element to the cylinder or rod. The former elongate into the latter and then divide. According to whether division occurs in a short or long element, the daughter-elements are cubical or spherical in the former, cylindrical or rod-shaped in the latter case. This applies to single bacilli, to short chains, and to the leptothrix forms.

The species of bacilli are very numerous, and differ from one another (1) in the shape of the elements, (2) in motility, (3) in the power of forming filaments or leptothrix, and particularly (4) in the thickness and length of the elements. In some species the size and form of the element is very variable, and in many it is difficult to decide whether one has to deal with bacilli or bacteria; but the growth of the bacilli into leptothrix, and particularly their power of forming spores, is decisive, although neither of these events may happen owing to peculiar conditions.

Some bacilli, *e.g.* the common hay bacillus, are possessed of a flagellum at one end, and are therefore endowed with the power of locomotion; other species, *e.g.* the anthrax bacillus, are without such power. But even in the first case the power of locomotion is possessed by the bacilli only when single or in short chains, not by the longer chains or leptothrix.

Some bacilli are not capable of forming leptothrix filaments, whilst others possess it to an eminent degree, *e.g.* hay bacillus, anthrax bacillus, and the bacillus of malignant œdema; others, such as *Bacillus amylobacter,* the bacillus of leprosy and of tubercle, do not form leptothrix filaments.

As to variations in size, *Bacillus amylobacter,* and some forms occurring in ordinary putrefaction, are many times as thick as others, such as the hay bacillus, the anthrax bacillus, &c.

Many bacilli and bacillus filaments, *e.g.* hay bacillus and anthrax bacillus, degenerate on growing old, the protoplasmic elements becoming granular and breaking down altogether into *débris.*

Another mode of degeneration consists in the elements and the sheath curling up and swelling up, and ultimately breaking down into *débris.*

Bacilli are killed by drying, but they must be dried in thin layers for the process to succeed. At the temperature of boiling water they are invariably killed, *but not their spores.* Even heating them for several hours at a temperature above 55° C. or 60° C. kills them. Freezing kills them, but not their spores. Carbolic acid, corrosive sublimate, thymol, &c., kill them.

The power of forming spores is one of the most striking phenomena in the life-history of bacilli. These spores are generally oval when fully developed, spherical when immature; they are always of a bright glistening appearance, and take dyes either with difficulty or not at all; they are generally a little thicker than the bacilli within which they are developed. Their formation always takes place in this way; in one or other of the elementary cubical, spherical, or rod-like masses of protoplasm, there appears a bright dot; this enlarges at the expense of the protoplasm until in its fully developed state it has an oval shape. The whole of the protoplasm of an element is not consumed in the process, a small trace always remaining unused at one or both ends. The sheath enlarges, and the bacillus looks much thickened; then the sheath breaks, and the spore with the remnant of protoplasm becomes free. Soon this remnant disappears, if it had not disappeared while the spore was still contained within the sheath, and now the spore is free. Under the most favourable circumstances a spore may be formed in each elementary mass of protoplasm, or it may be only in a small number. In the first case, a consecutive series of spores is present in the bacilli; two spores if the bacillus be composed of two elementary cells; four in a

chain of four elementary cells, or a vast number in a leptothrix. In the second case, a bacillus composed of two or four elementary cells may contain only one spore at the end or in the middle, or one at each end, or two together in the middle; in the leptothrix spores are seen only at comparatively long intervals.

In some cases this spore formation closes the life-history of the bacillus, but this is not always the case; in some forms spore formation only occurs when there is an ample supply of oxygen (hay bacillus, anthrax bacillus). These spores represent, as it were, the seeds of the bacilli, and are capable of retaining their vitality under ordinary circumstances for very long periods, and it is through the spores chiefly that the particular organism is disseminated through the air. As before said, boiling will kill the bacilli, but the spores will in somes cases resist so well that their destruction is not assured by less than half an hour's exposure to boiling water. On this fact depends a very common plan of preserving various articles of food, &c. But in order to make sure that all bacilli have been destroyed it is well to repeat the process more than once; in this way the spores which have not been destroyed by the first boiling germinate, and before the resulting bacteria have time to produce a fresh batch of spores they are killed by the second. For research purposes this boiling process is frequently repeated several times in order to make quite sure that all have been destroyed.

Antiseptics, such as carbolic acid (5% to 10%), strong solutions of phenyl-propionic acid and phenyl-acetic acid, corrosive sublimate (1:300,000, *Koch*), does not kill them, though the spores were kept in these fluids for twenty-four hours.

Pure terebene, phenol (10%), corrosive sublimate (1%), does not kill the spores of *Bacillus anthracis*. This great power of resistance in the spores is probably due to the fact that each spore is enveloped in a double sheath, an internal probably of a fatty nature, and an external probably of cellulose. This property can be taken advantage of to separate bacilli from bacteria and micrococci, which have not the power to resist boiling water.

(*a*) *Septic bacilli.*

Bacillus subtilis, the hay bacillus, is very common and widely distributed; it occurs in almost every organic substance rich in nitrogenous compounds which is left exposed to the air to decompose. If an infusion of hay be made and set aside in a warm place for a few hours, covered with a glass plate, it will be found to be swarming with this bacillus; it will grow equally well in any fluid containing the necessary nitrogenous compounds.

Bacillus septicus occurs in earth, in putrid blood, and in many putrid albuminous fluids. It is non-motile, and is capable of forming leptothrix. There are various species, all anaërobic, but they will not grow in a fluid containing micrococci, *Bacterium termo*, or *Bacillus subtilis.*

(*b*) *Zymogenic bacilli.*

There is one species definitely known, namely, the *Bacillus butyricus* (*Bacillus amylobacter, Clostridium butyricum, Ferment butyrique,* Pasteur). This bacillus has the same morphological characters as regards length and thickness of the rods, power to form leptothrix, and as regards motility, as the *Bacillus subtilis,* it forms zooglœa and is anaërobic.

(*c*) *Pigment bacilli.*

Bacillus ruber, found in boiled rice (*Bacillus synsyanus,* Neelsen), causes the blue colour of milk after the milk has become acid.

(*d*) *Pathogenic bacilli.*

Among these may be mentioned the bacilli of septicæmia, glanders, swine plague, malignant œdema, anthrax, tubercle.

The remaining forms of minute organisms which require mention are the VIBRIONES and SPIRILLA. Of the former there are two varieties, *V. rugula* and *V. serpens.* They consist of rods about 0·008 mm. to 0·016 mm. in length, and curved either like a **C** or an **S**. They are single or form chains of two. Their protoplasm is always slightly granular. They are found in putrefying organic substances, and often form continuous masses, the individuals interlacing in all directions (*Klein*).

SPIROBACTERIUM (Spirillum).

Spirilla are filaments of a spiral shape, motile, and owing to their shape follow a spiral course when moving.

Septic spirilla are found in all kinds of putrefying organic substances. The spirillum found in the tartar of the teeth is one of these, of which there are several forms.

The most important of the spirilla is that found in the blood of patients suffering from relapsing fever; they are found in the greatest numbers when the fever is at its height, gradually disappearing as the fever diminishes to return with the next attack.

Bacteria, Relation of, to Disease. The "germ theory of disease," if universally applied, would account for all diseases as the result of the action of some minute organism upon the tissues and structures of the animal body.

Stated very briefly, it amounts to this—that a particular micro-organism, being introduced into the animal body, will set up a train of symptoms of a definite character—in fact a disease, and that the same organism will always, under the same conditions, set up the same train of symptoms—that is to say, the organism and the symptoms are in the relation of cause and effect. Assuming this theory to be true, and that in any given case the organism has been isolated and its life processes carefully studied, it is conceivable that means may be found, either to prevent its entry into the animal body, or, being there, to combat its effects upon it by setting up conditions which will interfere with or altogether prevent its development and the results which are supposed to flow from it It is obvious that such a theory of the origin of disease gives great hope that it may be possible to stamp out certain diseases, at all events by destroying the conditions under which the organisms which cause them, live and multiply: in fact, that the prevention of disease instead of its cure would become the function of the physician.

The researches of Cohn, Koch, Pasteur, and others on the disease known as splenic fever

clearly pointed to an organism as the cause, and we are now able to assert as the result of these researches that, if a small quantity of a fluid in which this bacillus, the *Bacillus anthracis,* is growing, and that only, be injected into an animal, that animal will exhibit a train of symptoms which are characteristic of the disease known as splenic fever, and which undoubtedly is such (see ANTHRAX). In this particular case the careful study of the life processes of the bacillus, and the investigation of the circumstances under which animals and man have become affected by the disease, have enabled us to do much to prevent it by destroying the conditions which favoured the growth of the bacillus in the soil, by carefully isolating cattle which have been pastured on infected land, and so preventing the carriage of the organism from one place to another; and lastly, by subjecting the wool which was the medium by which the infection was conveyed to human beings to suitable processes the workmen are protected against the bacillus, and a large amount of disease and suffering undoubtedly prevented. Whether the origin of the disease in a micro-organism be considered proven or not, the the benefit which has followed on the adoption of those measures best calculated to prevent the dissemination of this particular bacillus is such that it has formed the basis of special legislation, and, so far as our present knowledge goes, we must consider the origin of splenic fever in an organism as practically proved.

Taking now a hypothetical case, and assuming that a certain organism is found invariably to accompany a certain train of symptoms, it is perhaps not unnatural to connect the organism and the symptoms in the relation of cause and effect. It will be well here to quote the opinion of Koch as to the nature of the evidence required to justify such a conclusion. Dr Klein, in the introduction to his work 'Micro-organisms and Disease,' states it as follows: "In no instance can it be said to have *been satisfactorily proved* that a particular infectious disease is due to a particular micro-organism if any one of the following conditions remains unfulfilled:—(1) It is absolutely necessary that the micro-organism in question be present either in the blood or the diseased tissues of the man or of an animal suffering from the disease. In this respect great differences exist, for in some infectious diseases the micro-organisms, although present in the diseased tissues, are not present in the blood; while in others they are present in large numbers in the blood only, or in the lymphatics only. (2) It is necessary to take these organisms from their nidus, from the blood or the tissues as the case may be, to cultivate them artificially in suitable media, *i.e.* outside the animal body, but by such methods as to exclude the accidental introduction into these media of other micro-organisms; to go on cultivating them for several successive generations, in order to obtain them free from every kind of matter derived from the animal body from which they have been taken in the first instance. (3) After having thus cultivated the micro-organisms for several successive generations, it is necessary to re-introduce them into the body of a healthy animal susceptible to the disease, and in this way to show that this animal becomes affected with the same disease as the one from which the organisms were originally derived. (4) And, finally, it is necessary that in this so affected animal the same micro-organisms should again be found. A particular micro-organism may probably be the cause of a particular disease, but that really and unmistakably it is so can only be inferred with certainty when every one of these desiderata has been satisfied."

There is yet another difficulty to be surmounted when the conditions stated above have been apparently satisfied, which opens up a wide field for speculation. It does not altogether follow because an animal can be infected at one time and in a particular manner that it can be infected at another; nor is the converse always true that, because under certain conditions the animal fails to become infected, it is immune from that particular disease. Nor is this all; it is very difficult to understand why the pathogenic organisms are able to resist the destructive action of the healthy tissues whilst the non-pathogenic organisms are unable to do so. Again, the *Bacillus anthracis* will multiply in man and in the herbivora, and produce the well-known phenomena of the disease, whereas it is not capable of doing so in the pig; yet, so far as artificial cultivations outside the body are concerned, it is of no consequence whether the animal broth in which they are grown be made from the flesh of one animal or another. We are therefore driven to the conclusion that there is some essential difference between the *living* tissues of these animals which gives immunity to one and renders another species susceptible. We may suppose that the tissues of some animals produce some chemical substance which renders the development of certain organisms difficult if not impossible, and that in this way those animals are protected against the attacks of the organism in question. Hereditary susceptibility to certain diseases in man may be explained on this hypothesis, and, instead of supposing the organism to be handed down from parent to child, we may conceive a congenital absence of the power of producing the material which would render the production of the disease difficult or impossible. Though the acceptance of this hypothesis does not necessarily exclude the direct transmission of the specific organism, we have yet to face another most important and as yet unanswered question: Do the organisms themselves cause the disease, or is it the result of the action of substances produced by them upon the tissues and organs of the affected animal? At first sight it may appear to be of little consequence *how* the result is brought about provided it be distinctly traceable to the operation of a specific organism, but from the point of view of preventive medicine the question may be of the greatest importance. The exact cause of death, for example, in anthrax is not certain; some authorities hold that the bacilli by reason of their enormous numbers consume the oxygen of the blood, which is necessary for their growth and development, and that the true cause of death is asphyxia; unfortunately for this theory animals have been known to die with all the

symptoms of anthrax poisoning after inoculation, and it has required considerable care to discover the bacilli in the blood after death. In these cases the cause of death must have been some chemical alteration produced in the blood and tissues other than the mere abstraction of the oxygen for the maintenance of the bacilli. Underlying this question is another which will be discussed under PTOMAINES. It will be sufficient here to say that the direct connexion between an organism and a specific disease has been proved in but a very few cases; and while it must be acknowledged that there is great probability of the causation of disease by organisms, it must be remembered that the proof is exceedingly difficult, and that it to a large extent involves the consideration of complex chemical phenomena occurring in the tissues of the animal body on which our information is so exceedingly limited that it can be hardly said to exist at all. The absolute truth or otherwise of the hypothesis does not interfere, however, with its practical value, and the results which have flowed from its acceptance have been of the very greatest benefit to mankind.

BAD″GER (băj′-ĕr). *Syn.* ME′LES, L.; BLAIREAU, Fr.; DACHS, Ger. The *Ursus me′les*, Linn., one of the plantigrade carnivora, a burrowing nocturnal animal, common in Europe, Asia, and North America. Since the extirpation of the bear, the badger is the sole representative of the ursine family in our indigenous zoology. Its habits are "nocturnal, inoffensive, and slothful; its food consists of roots, earth-nuts, fruits, the eggs of birds, insects, reptiles, and the smaller quadrupeds; its noxious qualities are consequently few and of slight moment, and by no means justify the exterminating war unintermittently waged against it" (*Brande*). Its "muscular strength is great, its bite proverbially powerful; and a dog must be trained and encouraged to enter willingly into combat" with it (*id.*).

Uses, &c. The flesh of the badger is prized as food; the skin used for pistol furniture; the hair made into brushes. The American badger is commonly called the GROUND-HOG. The Cape badger produces HYRACEUM (which *see*).

BAD′IANE (-e-āhn). [Fr.] *Syn.* BAD′IAN, B.-SEED. Star-anise seed.

BADI″GEON (bă-dĭzh′-ōne; băd′-e-zhŭn‡ or bă-dĭj′ŭn‡—Smart). Among operatives and artists, any cement used to fill up holes and to cover defects in their work. Among statuaries, a mixture of plaster and freestone is commonly used for this purpose; among joiners and carpenters, a mixture of sawdust and glue, or of whiting and glue; and among coopers, one of tallow and chalk. The name is also given to a stone-coloured mixture used for the fronts of houses, and said to be composed of wood-dust and lime, slaked together, stone powder, and a little ochre, umber, or sienna; the whole being mixed up with weak alum water to the consistence of paint, and laid on in dry weather.

BAEL. [Nat.] *Syn.* INDIAN BAEL, BEL*; BAEL, B. IN′DICUS, BE′LA, B. IN′DICA, L. The *Œg′le marmelos*, Correa (*Cratæva m.*, Linn.); one of the Aurantiaceæ (DC.). Dried half-ripe fruit imported from the East Indies, under the name of INDIAN BAEL. Astringent and refrigerant; highly extolled in chronic dysentery, diarrhœa, English cholera, and relaxations generally. It is also used in bilious fevers, hypochondriasis, melancholia, &c. Root-bark, stem-bark, and expressed juice of the leaves, particularly the first, also used in the same cases in India. Ripe fruit fragrant and delicious; used, in the East Indies, as a warm cathartic, and regarded as a certain cure for habitual costiveness. Mucus of the seeds used by painters as size; also as a cement. Unripe fruit used to dye yellow. It is generally administered under the form of DECOCTION or LIQUID EXTRACT (which *see*).

Waring gives the following caution as to purchasing bael in India:

"In bazaar specimens, the wood-apple (fruit of the *Feronia elephantum*) is often substituted for bael. Though they bear a close resemblance externally, they can easily be distinguished by opening them. In the true bael there are in the centre of the pulp a number of cells, from five to eighteen, each containing one or more seeds and glutinous mucus, whilst in the wood-apple there are no cells, and the ends are embedded in the pulp."

BAGASSE′ (-găs′). [Fr.] The dry refuse stalks of the sugar cane as they leave the crushing-mill. Used as fuel in the colonial sugar-houses.

BAGG′ING. The cloth or materials of which bags or sacks are made. In *agriculture*, applied to a method of reaping corn by a chopping, instead of a drawing cut. See RATS.

BAHIA POWDER. See ARAROBA.

BAIN-MARIE. [Fr.] In *old chemistry*, a water-bath; also, sometimes, a sand-bath. In *cookery*, a shallow vessel containing heated water, in which saucepans, &c., are placed, when it is necessary either to make them hot, or to keep them so without allowing them to boil. It is extremely useful in making sauces, warming soups and small dishes, and when dinners are delayed after they are ready to be served.

The bain-marie, as usually supplied with sets of cooking utensils, is a somewhat costly appliance of tinned copper. A very excellent substitute for it can be made by setting an earthenware vessel, jar, or jug, covered or not, as the case requires, in an ordinary saucepan, and pouring water into the latter until it is a little more than half full. If it is necessary to heat the water to boiling, it is well to place a dishcloth at the bottom of the saucepan, to prevent the earthen vessel touching the metal. This device is very useful in the preparation of foods which are liable to stick to the bottom of the pan and burn. See BATH WATER, BATH OIL, &c.

BA″KING (bāke′-). *Syn.* ACTION DE CUIRE AU FOUR, Fr. The process of cooking, or of heating, drying, and hardening any substance in an oven or kiln, or by the rays of the sun; the art or trade of a baker‡; also technically, a batch or ovenful, or the quantity baked at once (= FOURNÉE, Fr.).

In *cookery*, baking is, perhaps, of all others, the cheapest, most convenient, and best way of dressing dinners for small families, where a good domestic oven is at hand. Though the flavour of baked meat is generally considered barely equal

to that of the same parts roasted, there are some joints and dishes to which it appears particularly suitable. The difference in flavour between baked and roasted meat is very largely, if not entirely, due to the want of ventilation of the oven. Minute traces of very offensive compounds which result from the decomposition of fat by heat being the cause, the greatest possible care should be taken to keep the sides and shelves of the oven scrupulously clean, and to bake in pans of such depth that no spilling or boiling over of gravy or fat can occur; in this way baked meat can be made practically equal to roast, and at much less expense for fire, especially in a close range. Among these may be mentioned legs and loins of pork, legs and shoulders of mutton, fillets of veal, &c. A baked pig, if it has been occasionally basted, and the heat has not been too great, eats equal to a roast one. Geese and ducks treated in the same way are also excellent. A baked hare which has been basted with raw milk and butter also eats well; and so do various pieces of beef, especially the buttock. Cooks tell us that this last should be sprinkled with a little salt for a day or two before dressing it, and after being washed is preferably baked, along with about a pint of water, in a glazed earthen pan tied over with writing paper, 'three or four times thick.' A baked ham is said to be preferable to a boiled one—to be tenderer, fuller of gravy, and finer flavoured. It should be soaked in water for about an hour, wiped dry, and covered with a coarse thin paste or batter. Ordinary dishes require similar treatment in baking to that given them when roasted.

For domestic use, where the kitchen-range does not include a really good oven, the portable articles known as a 'Dutch oven' and an 'American oven,' form an excellent substitute, admirably adapted for small joints, poultry, &c., all of which, when these utensils are skilfully employed, possess a delicacy and flavour fully equal to the same when roasted; whilst not more than one half the fire is required for the purpose. According to Miss Acton they also "answer excellently for delicate sweet puddings, and for cakes." See BREAD, CAKES, ROASTING, &c.

Baking Pow'der. Tartaric acid, 8 oz.; bicarbonate of sodium, 10 oz.; rice flour, 12 oz. All to be thoroughly dried before mixing. See POWDERS.

Baking Powder, Borwick's German, is an artificial fermentation powder, compounded with coarse maize-flour (*Gädike*).

Baking Powder, Goodall's, is a compound of 2 parts of rice flour with 1 part of a mixture of tartaric acid and bicarbonate of sodium (*K. Boschan*).

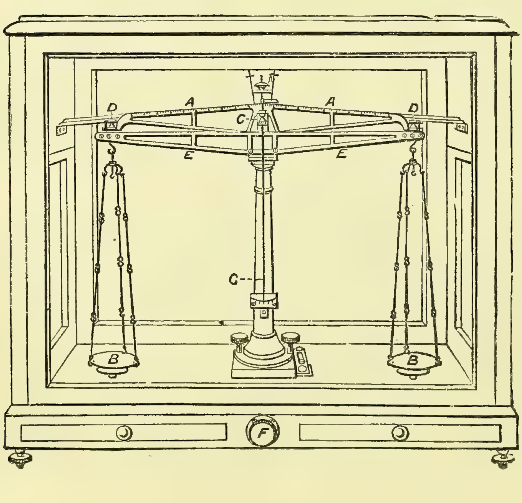
Baking Powder or Yeast Powder, Professor Horsford's (Cambridge, U.S.). This is a powder supplied in two packets. The one contains an acid phosphate of lime and magnesia made up with a certain quantity of flour, and the other is bicarbonate of sodium, with a little chloride of potassium.

BAL'ANCE. As in the processes of gravimetric analysis the chemist has to determine the weights of the different substances employed, as well as found, it will be self-evident that—for his results to be trustworthy—the balance which he employs must be perfectly accurate and reliable.

The accompanying drawing, from Roscoe's 'Text-book of Chemistry,' represents a common form of chemical balance.

The apparatus consists of a perforated brass beam (A A), turning round a horizontal axis midway between its extremities. This axis is a triangular knife-edge of agate (C), which rests upon a horizontal agate plane attached to the upright brass pillar. To each end of the beam light brass pans (B B) are hung, each pan being suspended by an agate plane upon an agate knife-edge fixed on the end of the beam at (D D). This arrangement is necessary, in order to reduce as much as possible the friction of the edges on their supports, which friction, if unchecked, would seriously impair the sensibility of the balance.

In order to prevent the agate edges from being worn away by constantly rubbing on the agate planes, the beam and the ends (D D) are supported by the brass arm (E E), when the balance is not in use, so that the agate surfaces are not in contact. The beam and pans are released, when required, by turning the handle (F). The movement of the brass arm (E E) is accomplished by means of a rod descending through the upright brass pillar, and resting on a simple eccentric, which can be turned by the handle (F) so as to raise or lower the beam. The substance to be weighed (contained in a stoppered tube, watch glass, &c.) is placed in one of the pans, and weights added one by one to the other, until the beam is in equilibrium; this is ascertained by the long pointer (G) oscillating to an equal distance on each side of the central mark or index, the latter being subdivided into equal spaces, so that the extent of the oscillations can be measured. A spirit level is also a necessary appendage to the instrument, since it enables the operator to place the beam exactly horizontal.



The beam of every good chemical balance is graduated into tenths and hundredths. This saves the trouble of placing very minute weights on the

scale, since it enables the operator to weigh the milligramme and its fractions by suspending a centigramme rider or hook on or between the indicated points of the graduated beam. A rider weighing one centigramme (0·01 grm.), placed at a point exactly midway along the beam, will balance a weight of 0·005 grm. in the opposite pan; if placed at a distance from the axis of one tenth the length of the beam, it will balance a weight of 0·001 grm. Or, generally, the weight indicated by the rider is directly proportional to its distance from the axis. The annexed engraving shows the form of rider used; it is made of either fine gold or aluminium wire.

The balance is enclosed in a glass case, which serves not only to protect it from dust, but also allows the weighing to be carried on unaffected by the air outside, in which the prevalence of draughts proves a source of considerable annoyance to the operator. The front of the scale case generally consists of three parts, viz. a fixed centre piece and two lateral frames or doors, all of course of glass. It is of importance that the air inside the balance case should be perfectly dry, since a humid atmosphere would not only affect the weight of many hygroscopic substances when placed in the pans, but would likewise be liable to attack the instrument itself. To guard against these contingencies, a small shallow vessel, *e.g.* a crystallising basin, containing freshly burnt lime or chloride of calcium in small pieces, or (in default of these) a little oil of vitriol, should be kept in the case. The instrument must also, of course, be kept in a separate room, away from the fumes of the laboratory. A balance capable of weighing 70 or 80 grms. in each scale will be found to meet the requirements of most chemists.

Fresenius says, "The ACCURACY of a balance depends upon the following conditions:

"*a.* The fulcrum must be placed above the centre of gravity of the beam.

"*b.* The suspension points of the scales must be on an exact level with the fulcrum.

"*c.* The beam must be sufficiently strong and inflexible to bear without bending the greatest weight that the construction of the balance admits of.

"*d.* The arms of the balance must be of equal length; *i. e.* the points of suspension must be equidistant from the fulcrum or point of support.

"The SENSIBILITY or DELICACY of a balance depends upon the following conditions:

"*a.* The friction of the edges upon their supports must be as slight as possible.

"*b.* The centre of gravity must be as near as possible to the fulcrum.

"*c.* The beam must be as light as possible."

And we may further add:

d. The sensibility is greater, the greater the length of the beam.

The following are the tests given by the same authority for the accuracy and sensibility of a balance:

"1. The balance is in the first place accurately adjusted, if necessary, either by the regulating screws, or by means of tinfoil, and a milligramme weight is then placed in one of the scales. A good and practically useful balance must turn distinctly with this weight; a delicate chemical balance should indicate the one tenth of a milligramme with perfect distinctness.

"2. Both scales are loaded with the maximum weight which the construction of the balance will admit of; the balance is then *accurately* adjusted, and a milligramme added to the weight in one scale. This ought to cause the balance to turn to the same extent as in 1. In most balances, however, it shows somewhat less on the index.

"3. The balance is accurately adjusted, should it be necessary to establish a perfect equilibrium between the scales, by loading the one with a minute portion of tinfoil (this tinfoil must be left remaining upon the scale during the experiment); both scales are then equally loaded, say with about 50 grms. each, and if necessary the balance is again adjusted (by the addition of small weights, &c.). The load of the two scales is then interchanged, so as to transfer that of the right scale to the left, and *vice versâ*. A balance with perfectly equal arms must maintain its absolute equilibrum upon the interchange of the weights of the two scales.

"4. The balance is accurately adjusted; it is then arrested, subsequently set in motion, and again allowed to recover its equilibrium; and this process should be repeated several times. A good balance must invariably reassume its original equilibrium.

"A balance of which the end edges afford too much play to the hook resting upon them, so as to allow the latter slightly to alter its position, will show perceptible differences in different trials. This fault, however, is possible only with balances of defective construction.

"A balance to be perfectly useful for the purposes of quantitative analysis *must* stand the first, second, and last of these tests. A slight inequality of the arms is of no great consequence, since this may be readily and completely remedied by the manner of weighing." See WEIGHING and WEIGHTS.

Balance, Hydrostat'ic. See SPECIFIC GRAVITY.

Balance, Tor'sion. A delicate instrument, invented by Coulomb, for measuring the intensities of electrical forces.

BALANINUS NUCUM (from the Greek word *βάλανος*, an acorn), Germar. THE NUT WEEVIL. A notable enemy to growers of nuts of all kinds, this, like the *Anthonomus pomorum*, is but a diminutive weevil. Kentish filbert growers realise its havoc too frequently, though it must be said it is not common to find one who knows the veritable offender or who is acquainted with its actual *modus operandi*. The gourmet, loving freshly gathered filberts with his wine, often anathematises this interferer with his delights, and the schoolboy cracking nuts with his teeth gets his mouth filled ever and anon with bitter-flavoured dust.

There are, as many persons are probably aware, large filbert and cob-nut plantations in Kent. In some instances one producer has from twenty even to forty acres of land planted with nut trees, whose returns are very large in favourable seasons. In these this weevil, the balaninus,

often considerably reduces the returns by causing a percentage of the nuts to fall off before they can be picked, by reducing the weight of the nuts sent to market, by ruining their kernels, and by spoiling the samples and injuring the reputation of the growers, of which they are very chary, as nowhere in the world can the filbert or full-beard, *Corylus avellana*, be grown so well and with such unique sweetness of flavour as upon some soils in certain situations upon the Greensand formation in parts of Kent. The filbert is much more liable to be injured by the balaninus than other nuts, as for example the cob-nut, an altogether larger and less delicate nut. In passing, it may be remarked that a demand has sprung up from America for this nut as it is so large and looks so well at dessert, and it is in some degree superseding the filbert. It is not so subject to the balaninus as the filbert. This may be that its shell being much thicker than that of the filbert, it is difficult for the grub to make its way out of it when the time arrives, or that the weevil cannot so well get its rostrum through the thick husk, or envelope, and the green rind of the future shell.

This insect is known in most of the countries of Europe as injuring nuts. Taschenberg and Kaltenberg both describe it as destructive to nuts in Germany, though Köllar does not allude to it. A large fruit-grower in central France writes that this weevil occasionally does much mischief to the peculiar nuts, *noisettes*, grown there, larger than hazel-nuts and more globular in form than filberts. There are two species of weevil in America, called by Fitch ('Reports on Noxious Insects in New York,' 3, 4, and 5) *Balaninus nasicum* and *Balaninus rectus*, whose grubs live in nuts and whose history and habits are precisely similar to those of the European species.

Life History. The *Balaninus nucum* is a species of the genus Balaninus, of the family CURCULIONIDÆ. Towards the end of June the weevil may be first found upon the filbert, cob, and other nut trees. It is brown in colour with a chocolate shade, having a reddish yellow down or pubescence upon its body, which is about two and a quarter lines. Upon the elytra—wing-cases—there are rows of dots or marks. The head is elongated into a slightly curved spatulate rostrum, or snout, of a brown colour, longer than its body. Westwood says of this that in this disproportionate length of the rostrum it exceeds every other British weevil ('Introduction to the Modern Classification of Insects,' by J. O. Westwood, F.L.S.). As in the weevil, *Anthonomus pomorum*, there are club-shaped antennæ with rectangular joints placed about half way up the rostrum.

It is averred by several entomologists that the female weevil uses its wings most sparingly, and that it is the male which flies into one's face and comes down with a buzz upon the leaves of the trees in the nut plantations. This does not appear to be sufficiently verified, and it is thought that the wings are used equally by both sexes, though not frequently by either.

About the beginning of July the female weevil makes its way to the clusters of nuts, by this time formed and distinct upon the stem, and after considerable investigation in order to obtain the fittest for the purpose, selects one in which to place an egg. With its preternaturally long snout it bores a hole through the envelope, or calyx, and the soft green shell, and laying an egg uses its snout again to push the egg as far as possible into the milky pulp stored up for the sustenance of the embryonic kernel, at this time about the size of a pin's head. In the course of eight or nine days a maggot is hatched, and soon commences operations upon the kernel, taking care, with the marvellous instinct of the larvæ of all weevils which feed upon kernels, grain, and pulse, not to touch its germ, or to leave this until the last.

By the time the maggot has attained its full size the kernel has been pretty well despoiled of its substance, and it seeks to quit the nut. Since its entrance, however, the shell has hardened and formed walls as of a prison-house, into which it is compelled to gnaw a hole in order to escape. For this purpose Nature has furnished it with jaws well adapted for biting this hard substance.

In length this maggot is rather more than a third of an inch; it is white, with a shiny black head; its body is fleshy and without legs, in place of which it has a row of tubercles on either side, with which it manages to crawl or jerk itself along with much rapidity.

After the aperture has been made in the shell it escapes from its prison-house, though it is a work of some difficulty for it to squeeze its fat body through the little round orifice gauged by its head. When this has been accomplished it falls to the ground and wriggles down between the clods into the earth somewhat deeply, and makes a habitation, or little cell, in which it remains snugly curled up until the early spring time, when it puts on pupal, or pseudo-pupal form, and soon comes out a perfect weevil, living upon the leaves of filbert and other nut trees until its mission has been accomplished.

Prevention. The only opportunity of working against this weevil is when in grub form it is in the ground near the nut trees, from September until March. Dressings of lime or of gas lime would be likely to kill the grubs, and applications of ashes, earth, or sawdust, soaked in paraffin or carbolic acid solution, would make their quarters unbearable if they did not kill them. These dressings should be dug in deeply, as the grubs go down some distance. Nut plantations are dug in the late autumn or winter, and the land is hoed in the early spring with prong hoes to break the clods, to level the ground, and move the soil. After an attack of weevil, this spring hoeing should receive more attention and be done deeper and better than usual, in order to kill the maggots or destroy the pupæ which may have been formed.

It would hardly avail much to pick up the nuts that have fallen to the ground, in consequence of the work of the weevils, as recommended by Köllar and others, as in nine cases out of ten it will be found that the maggots have escaped before or as soon as the nuts have fallen.

Remedies. No practical remedial measures can be recommended in this case. Birds are fond of the weevils, and especially the titmouse. Both the large and the small species of this useful bird

may be seen upon the nut bushes industriously hunting for them and other prey, prying into every chink in the bark, sometimes with their heads downwards in apparently the most break-neck position, after their manner ('Reports on Insects Injurious to Crops,' by C. W. Whitehead, F.Z.S.).

BALANITES (BALANITES ROXBURGHII, Planch.), Desert Date, a thorny shrub of India, Egypt, and West Coast of Africa. When fermented it yields an intoxicating liquor used by the African negroes; the unripe fruit is called EGYPTIAN MYRABOLAN. In India the ripe nut when bored and emptied is filled with powder and converted into a small bomb which explodes with a loud noise.

BALANITIS. Inflammation of the opposing surfaces of the glans penis and prepuce—not uncommon in dogs, and very loathsome in a house or companion dog.

Mr Dalziel gives the following treatment as efficacious:

"Bathe the parts very frequently with cold water, give a strong dose of ordinary black draught, and the following medicines:

"Bicarbonate of soda and bicarbonate of potash, of each 2 dr.; tincture of henbane, 3 dr.; Mindererus' spirit, 1½ oz.; water to 6 oz.—*Dose* for a 40 lb. to 50 lb. dog, a tablespoonful four or five times a day.

"Give the dog barley-water to drink and but little meat. Porridge, milk, and broth, with green vegetables, will be most suitable."

BALANOPHORA (Nat. Ord. BALANOPHOREÆ). Under this head are collected a few most anomalous plants of very different structure, agreeing in the absence of green colour and of leaves, and in their parasitism upon the stems and roots of other vegetables.

BALANOPHORA ELONGATA, Bl. Candles are made in Java from the wax secreted by this member of the order.

The Himalayan tribes, Tibetans, &c., make cups from knots formed on the roots of oaks, maples, &c., by the parasitical BALANOPHORA INVOLUCRATA, Hook, f. Some of these, esteemed antidotes to poison, fetch a great price.

BALATA. BALATA GUM. An exudation from the bullet tree, *Mimusops balata.* As regards properties this substance stands midway between gutta percha and caoutchouc, combining in some degree the elasticity of the one with the ductility of the other. Warmed it easily softens, becomes plastic, and can be easily moulded. It is completely soluble in benzole and carbon disulphide in the cold. Its uses are similar to those of gutta percha.

BALAUSTINE FLOWERS. The flowers of the pomegranate, sometimes used in medicine as an astringent.

BALD'NESS (bawld')-. *Syn.* ALOPECIA, CAL'-VITAS, CALVI''TIES (vĭsh'-e-ēz), L.; CALVITIE, CHAUVETÉ, Fr.; KAHLHEIT, KAHLKOPF, KAHLKÖPFIGHEIT, Ger. Primarily, absence or loss of any natural covering; appr., destitution or loss of hair, more especially of that of the top and forepart of the head. In *botany,* absence of the beard or awn.

Grey hair and baldness dependent on old age are natural consequences of man's infirmity, and must be regarded as evidence of failing vigour, rather than in the light of a disease. Premature loss of hair may be induced by various causes. It is common after severe fevers, and is frequently caused by external pressure, friction, or violence, and by such other local actions and conditions which, when long continued, interrupt the normal functions of the skin. Persons with a consumptive, scorbutic, scrofulous, or syphilitic taint, or of a generally bad habit of body, frequently lose their hair early. In these cases it probably arises from debility or paralysis of the cutaneous vessels, and the consequent insufficient nutrition of the hair-bulbs. When it occurs in persons under the middle age, and apparently enjoying good health, it may be often traced to the pernicious practice of constantly wearing a hard non-ventilating hat, or to disordered stomach, habitual smoking or hard drinking, irregular habits, or late hours. Excessive anxiety or grief, and intense study and thoughtfulness, also tend to promote the early decay of the hair. One form of baldness, *Alopecia areata* (or simply area) is characterised by more or less sudden loss of hair over limited areas, generally more or less circular in form, and is apparently due to some local failure of nerve-power, as it is generally accompanied by other signs of feeble nutrition of the area affected. The natural baldness of the aged, and frequently the premature baldness of earlier years, arises from the gradual attenuation of the scalp, which ultimately becomes too thin to afford room for the performance of the functions of the hair-producing organs, and too scantily supplied with blood for their due nutrition and support.

Treatm. The baldness of senility and that arising from the permanent injury or destruction of the hair-bulbs admit of no cure, notwithstanding the daily assurances of advertising impostors to the contrary. In other cases, when a disposition to baldness exists, shown by the hair falling off in large quantities, or ceasing to grow with its usual vigour and rapidity, the frequent but gentle use of the hair-brush, and of any bland stimulating oil, pomade, or wash, if adopted in time, will generally prove sufficient to arrest the progress of decay, and, very frequently, to restore the hair to its pristine condition. The head may be advantageously washed in cold water, at least once a day; or what is better, a shower-bath may be taken on rising in the morning. Should this plan not succeed, the head, or the upper part of it, may be shaved, and a wig, or a scalp, adopted for a time. The effect of keeping the hair closely cropped or shaved is to make it grow thicker, stiffer, and stronger, and this often when all other means fail.

Among more active and less common remedies for baldness may be mentioned—liniment of ammonia, compound camphor liniment, liniment of chloroform and of mustard, acetum cantharidis considerably diluted.

The celebrated John Wesley recommended rubbing the part morning and evening with a raw onion until it became red, and then applying a little honey. The vendors of Rowlands' 'Macassar Oil' recommend the head to be rubbed

with a towel (or hair-brush) until somewhat red, each time before applying their nostrum; and the advice is certainly good, as independent of the stimulus thus given to the skin, and the increased flow of blood through the minute vessels of the scalp, it is rendered more absorbent and sensitive to the action of medicaments. At the same time the reader must be cautioned against placing any reliance on external applications, unless he assists their action by due attention to diet, exercise, ventilation, and such other matters as tend to promote the general health and vigour of the body.

The substances usually employed to medicate hair cosmetics, the general management of the hair, and the formulæ for various applications to promote its growth, preservation, and beauty, are noticed in the articles HAIR, HAIR COSMETICS, POMADES, OILS, WASHES, &c., to which the reader is referred.

BALEEN′ (-lēne′). [Fr. *baleine.*] The fisher's name for whalebone.

BALL (bawl). [Eng., Ger., Swed.] *Syn.* BALLE, BOULE, Fr.; BAL, BOL, Dan.; GLOBULUS, PI′LA, L. In *commerce, veterinary medicine, perfumery,* &c., applied to various substances made up into a globular, spheroidal, or even a cylindrical form, as ash-balls, horse-balls, soap-balls, &c.

BALLOON′ (-lōōn′). *Syn.* BALLON, Fr., Ger. Any hollow spherical body of which the sides are extremely thin or attenuated in comparison with its diameter or bulk. In *aërostatics,* a machine or apparatus for elevating and sustaining bodies in the air. In *chemistry,* a globular glass receiver, with either one or two necks (= GROS RÉCIPIENT, BALLON, Fr.; GROSSE R., Ger.). In *pyrotechny,* a hollow case or ball of pasteboard filled with fireworks or combustibles, which explodes in the air on being fired from a mortar.

Balloon. In *aërostation,* a bag or hollow pear-shaped vessel made of varnished silk or other light material, and inflated with some gas or vapour lighter than the air, as hydrogen, carburetted hydrogen, heated air, &c., so as to rise and float in the atmosphere. When filled with gas it is called by way of distinction an AIR-BALLOON (*aërostat,* &c., Fr.; *luft-ball, luft-schiff,* &c., Ger.); when with heated air, a FIRE-BALLOON or MONTGOLFIER B. (*ballon à feu,* &c., Fr.).

In the early days of aërostation, and indeed for some years afterwards, balloons were inflated with hydrogen gas, obtained by the action of sulphuric acid and water on iron filings or small fragments of iron; but this method of filling them ultimately gave place to the cheaper and more convenient supply afforded by the gas-light companies. Of late years the coal-gas furnished by the gas-works has been generally, if not solely, used for the inflation of balloons.

The principles of ballooning may be referred to the well-known difference in the specific gravity of bodies, and to the physical properties of the atmosphere. Pure hydrogen, weighed at the level of the sea, is about 16 times lighter than common air; but when prepared on the large scale and containing water and other impurities, it is only from 7 to 11 times lighter than the atmosphere. A globe of atmospheric air of 1 foot in diameter, under like circumstances, weighs $\frac{1}{25}$ *lb.*; a similar globe of hydrogen (reckoning it only as 6 times lighter than common air) will, therefore, have an ascensional force of $\frac{1}{30}$ *lb.* Now, the weight of the body of air which a balloon displaces must exceed the gross weight of the balloon and all its appendages in order for the latter to ascend in the atmosphere. The difference of the two weights expresses the ascensional force. The aërostatic power of balloons is proportional to their dimensions, in the ratio of the cubes of their diameters. Thus, it appears that a balloon of 60 feet diameter filled with common hydrogen will ascend with a weight of nearly 7000 *lbs.,* besides the gas case; whilst one of only $1\frac{1}{2}$ feet in diameter will barely float, owing to the less proportionate volume of gas to the weight of the case containing it. In round numbers the buoyancy of a balloon may be reckoned as equal to 1 *oz.* for every cubic foot of hydrogen it contains, *less* the weight of the case and appendages. The carburetted hydrogen supplied by the gas-works is much heavier than hydrogen gas, and consequently much less buoyant, for which due allowance must be made. That which possesses the least illuminating power is the lightest, and consequently the best adapted for aërostation.

The fabric of which the cases of air-balloons are made is strong thin silk, covered with an elastic varnish of drying oil or india-rubber, or, what is better, a solution of india-rubber in either chloroform or bisulphide of carbon; the netting is of strong light silk or flaxen cord, and the car of basket-work. Fire-balloons, on the small scale, are generally made of tissue-paper, and are inflated with the fumes of burning spirit of wine, by means of a sponge dipped in that liquid, and suspended just within the mouth of the apparatus. Owing to the increasing rarity of the atmosphere as we ascend from the earth's surface, balloon cases are made very much larger than is required to contain the necessary quantity of gas, to allow for its expansion as it rises into a rarer medium. A cubic foot of gas measured at the level of the sea occupies a space of two feet at an elevation of $3\frac{1}{2}$ miles.

The following *table* will prove useful:

TABLE *showing the relations between the Diameters, Surfaces, and Capacities of Spheres.*

Diameters.	Surfaces.	Cubical Contents.
1	3·141	·523
2	12·567	4·188
3	28·274	14·137
4	50·265	33·51
5	78·54	65·45
10	314·159	523·6
15	706·9	1767·1
20	1256·6	4189·
25	1963·5	8181·
30	2827·	14137·
40	5026·	33510·

See ATMOSPHERE, GAS, HYDROGEN, PARACHUTE, VARNISH, &c.

BALLOON'ING‡. The act, art, or practice of ascending or travelling in balloons; aërostation. A BALLOON'IST‡ is an aëronaut.

BALLS. The application of this term in *commerce, perfumery, veterinary medicine,* &c., has been already noticed. (See BALL.) The following may be inserted here:

Balls, Al'mond (ah'-mŭnd). *Syn.* BOULES D'AMANDE, Fr. *Prep.* 1. Spermaceti, 4 *oz.;* white wax (pure), 8 *oz.;* oil of almonds, 1 pint. Melt them together in a glazed earthenware vessel by the heat of a water-bath, and when the mixture has cooled a little, add essential oil of almonds, and expressed oil of mace, of each, 2 *dr.;* stir assiduously until it begins to cool, and then pour it into the moulds, which may be ounce gallipots with smooth bottoms (very slightly warmed), when it will form beautiful hemispherical cakes. Very fine.

2. Hard clarified suet, $1\frac{1}{4}$ *lbs.;* white wax, $\frac{1}{4}$ *lb.;* ess. oil of almonds, $1\frac{1}{2}$ *dr.;* oil of cloves (or of pimento), $\frac{1}{2}$ *dr.;* as before.

Uses, &c. To soften the skin, and in winter to prevent chaps and chilblains. Sometimes these balls are coloured, which is done whilst the mixture is in the liquid state. A rich pink or red may be given by a little alkanet root or dragon's-blood; a yellow, by palm oil or annotta; a blue, by a little finely powdered indigo; and a green, with an alcoholic solution of chlorophyl. The most appropriate tint for them is a pale yellow or amber.

Balls, Barèges (-răzhe'). *Syn.* BOULES DE BARÈGES, Fr. *Prep.* 1. Extract of soapwort, 3 *oz.;* good glue or gelatin, $1\frac{1}{2}$ *oz.;* water, 4 *oz.;* dissolve with heat, and add of sulphide of calcium, 6 *oz.;* common salt, 1 *oz.* (both in powder); mix thoroughly, and form the mass into balls weighing $2\frac{1}{2}$ *oz.* each, adding a little powdered gum, if required, to thicken it, and using powdered starch to roll them in.

2. Gelatin, 8 *oz.;* sulphide of calcium, 12 *oz.;* common salt, 2 *oz.;* water, q. s.; after solution and admixture, add carbonate of soda and Castile soap, of each (in powder), $2\frac{1}{2}$ *oz.* One ball is added to the water of a bath for an adult, to be used as a substitute for that of Barèges.

Balls, Bitter. *Prep.* 1. Powdered gentian, 2 *lbs.;* extract of gentian, 1 *lb.;* grains of paradise (ground), $\frac{1}{2}$ *lb.;* syrup, q. s.; mix with heat, and divide into half-pound rolls. For ALE.

2. To the above add of Spanish juice, $1\frac{1}{2}$ *lbs.;* previously softened with a little boiling water. For PORTER and STOUT. Both are used by fraudulent brewers, and by publicans in reducing their beer.

Balls, Black'ing. *Prep.* 1 (*Bailey's*). Gum tragacanth, 1 *oz.;* water, 4 *oz.;* dissolve, add of sugar-candy, 4 *oz.;* and afterwards, ivory-black and Prussian blue (in very fine powder), of each, 2 *oz.;* neat's-foot oil, 2 *fl. oz.;* thoroughly incorporate, and evaporate by a gentle heat, constantly stirring until of a proper consistence, then pour it into oiled moulds.

2. Gum arabic, moist sugar, and ivory-black, of each, $\frac{1}{2}$ *lb.;* lamp-black, $\frac{1}{4}$ *lb.;* glue (melted with a little water), 2 *oz.;* water, 1 quart, or q. s.; neat's-foot oil, $\frac{1}{4}$ pint; as before. Used by the shoemakers, harness-makers, &c., to blacken and polish leather. See BALLS, HEEL.

Balls, Breech'es. See BALLS, SCOURING.

Balls, Bronze. See BALLS, COPYING.

Balls, Cam'phor. *Syn.* CAM'PHOR-CAKES, CHAP'-BALLS‡, CHIL'BLAIN B.‡, &c.; GLOB'ULI CAMPHORA'TI, PLACEN'TÆ CAMPHORA'TÆ, &c., L. *Prep.* 1. Spermaceti and white wax, of each 2 *oz.;* almond or olive oil, $\frac{1}{4}$ pint; melt together by a gentle heat, add of camphor (in small pieces), 1 *oz.;* when dissolved, stir until partly cold, and then pour it into moulds, as directed under ALMOND-CAKES (*above*).

2. Clarified suet, 1 *lb.;* spermaceti and white wax, of each, 3 *oz.;* camphor, 2 *oz.;* as before.

3. Spermaceti cerate (Ph. L.), 1 *lb.;* spermaceti, 2 *oz.;* camphor, $1\frac{1}{2}$ *oz.;* as before.

4. To either of the above add of balsam of Peru, $\frac{1}{4}$ to $\frac{1}{2}$ *oz.;* and, after solution, either strain the mixture through muslin, or allow it to settle, and decant the clear portion from the dregs.

Use, &c. A popular preventive of chapping and chilblains. A little is well rubbed into the skin, previously washed clean and wiped dry. Some persons add colour and scent; but they are generally sold without either. The only suitable colours are amber, pink, or yellow. The best perfumes are allspice, ambergris, cassia, cloves, musk, nutmeg, rondeletia, vanilla, and violets. See BALLS, ALMOND (*antè*).

Balls, Clothes. See BALLS, SCOURING.

Balls, Contrayer'va. *Syn.* LA'PIS CONTRAYER'VÆ, GLOB'ULI C., L. Compound contrayerva-powder made into balls with gum-water. An obsolete preparation, once in great repute as a stimulant, tonic, diaphoretic, and absorbent.

Balls, Copying. These have a similar composition to 'heel-balls' (see *below*). For BLACK, the best colouring matter is lamp-black or plumbago with about half its weight of indigo; for a BRONZE COLOUR, bronze powder is substituted; and for a mellow BROWN, burnt terra di Sienna. These should be all in very fine powder. The semi-fluid mass is poured into small flat cylindrical moulds—paper pill-boxes answer the purpose well. Used by artists and amateurs to copy inscriptions, monumental brasses, and other slightly raised or sunken patterns; the ball being rubbed over the paper previously laid flat on the design, and held securely in its place. They are sometimes rendered more permanent by damping the wrong side with a sponge dipped in water, strong spirit, or oil of turpentine; or by passing the wrong side over a hot iron held with the face upwards.

Balls, Cosmet'ic. See SAVONETTES, &c. (also *above*).

Balls, Cream. See SAVONETTES, SOAP BALLS, &c.

Balls, Dog. See DOGS.

Balls, Gas'coign's. *Syn.* GLOB'ULI GASCOIG'NII, L. Gascoign's powder made up into small balls with thin mucilage. See POWDERS.

Balls, Heel-. *Prep.* 1. (*Ullathorne's.*) Beeswax, 1 *lb.;* suet, 4 *oz.;* melt together, and stir in of ivory-black (very finely powdered), 4 *oz.;* lamp-black (sifted), 3 *oz.;* gum arabic and sugar-candy, of each (in very fine powder), 2 *oz.;* and, when thoroughly mixed and partly cold, pour the composition into tin or leaden moulds.

2. To the last add of resin, 3 *oz.;* oil of turpentine, 2 *oz.*

3. Hard suet and beeswax, of each, 4 *oz.;* powdered gum, sugar-candy, and Venice turpentine, of each, 1 *oz.;* ivory-black and lamp-black, of each, 2 *oz.;* as before.

4. Suet and beeswax, of each, 4 *oz.;* lamp-black and brown sugar, of each, 8 *oz.;* common size, 5 *oz.;* melt together and stir until incorporated.

Uses, &c. Employed to black leather, and more especially by shoemakers for the edges of the soles; the ball being first rubbed on, and the part afterwards smoothed over with a burnisher or polished iron tool gently heated. Also used by artists to copy inscriptions, basso-relievos, &c. To produce a good article, the gum, colouring matter, and sugar must be in the state of extremely fine powder, and the mixture very carefully made; no lumps being left. Some persons dissolve the gum in a little water, and then stir the mixture over the fire until it acquires the proper consistence for moulding (as in No. 4, *above*); but the first is accounted the best method.

Balls, Horse-. See VETERINARY MEDICINE, &c.

Balls Martial. *Syn.* GLOB′ULI MARTIA′LES, L. *Prep.* 1. Those of the P. Cod. consist of tartarised iron mixed with aromatics, and made up into small globular masses.

2. (BOULES DE NANCY.) Equal parts of iron filings and red tartar, in fine powder, made into balls with proof spirit or brandy. Both are used as chalybeate tonics, either in the form of pills or dissolved in hot water. Seldom employed in England.

Balls, Physic. (Vet. Med.) See MASSES.

Balls, Poultry. See POULTRY.

Balls, Scent. See PASTILS (Toilet), PERFUMERY, POMAMBRA, SCENTS, &c.

Balls, Scouring. *Syn.* BREECH′ES BALLS, CLOTHES B., CARPET B., &c. *Prep.* 1. Curd soap (sliced), 1 *lb.;* water, 2 *oz.;* melt in a water-bath, or a glue-pot, and when cooled a little, add ox-gall and oil of turpentine, of each, 5½ *oz.;* mix well and roll or mould the mass into balls or cakes.

2. Fuller's earth, 2 *lbs.;* curd soap, 1 *lb.;* beat to a stiff paste with ox-gall, a sufficiency.

3. Soft soap and fuller's earth, equal parts, beat up with a little oil of turpentine, and either with or without a little essence of lemons.

Obs. The above are used to remove paint, grease, and dirt from cloth, carpets, &c. The spot, first moistened with hot water, is rubbed with the cake, and allowed to soak a few minutes, or to become nearly dry, when it is well rubbed with a little warm water and a brush or piece of woollen cloth, and afterwards rinsed in clean water, and finally rubbed dry and smoothed off with a piece of dry cloth or a dry brush. The last formula produces the composition so commonly vended about the streets of London in penny cakes.

4. Whiting and pipe-clay, equal parts; water, q. s. Used for soldiers' belts, trousers, &c.

5. Pipe-clay, 2 *lbs.;* fuller's earth, 1 *lb.;* whiting, ½ *lb.;* water, q. s.

6. Bath brick, 1 *lb.;* pipe-clay, 2 *lbs.;* soft soap, ¼ *lb.*; ox-gall, ½ pint.

7. To the last add of pumice-stone, in very fine powder, 6 *oz.*—*Obs.* The last four are used for cloth and leather, especially for drab and light-coloured coats, trousers, leather breeches, belts, and gloves. Rose pink, yellow ochre, umber, Irish slate, or other like colouring matter, may be added to produce any desired tint. White pepper, cloves, &c., are also occasionally added to drive away moths and insects; and orris-root, or essence of bergamot or of lemon-grass, as perfume.

Balls, Sweet. See BALLS, SCENT (*antè*).

Balls, Tan. The muddy sediment of tan-pits made into balls or lumps. Used by the poor for summer fuel.

Balls, Wash. See SAVONETTES, SOAP, &c.

BALM (bahm). *Syn.* BAL′SAMUM, L.; BAUME, Fr.; BALSAM, Ger. Primarily, balsam (of which it is a contraction); formerly and still popularly applied to anything assumed to be soothing, healing, or genial in its action, particularly if also aromatic or fragrant; but chiefly to medicines and liqueurs, supposed to possess these properties. See BALSAMS, LIQUEURS, QUACK MEDICINES, &c.

Balm. *Syn.* COM′MON BALM, GAR′DEN B.; MELIS′SA, L.; BAUME, MÉLISSE, Fr. The *Melis′sa officina′lis*, Linn., an aromatic perennial herb, a native of the south of Europe, but commonly cultivated in our gardens. It is reputed to be diaphoretic, diuretic, emmenagogue, exhilarating, nervine, and stomachic; and under the form of infusion (BALM TEA) has long been a popular remedy in hypochondriacal, hysterical, and nervous affections, and in amenorrhœa and chlorosis. It is still sometimes ordered as a drink in fevers and in hypochondriasis. The 'elixir vitæ' of the alchemist was largely prepared from "the herb melissa."

Balm of Gilead, or Balm of Mecca. This oleo-resin, which is supposed to be identical with the Balm of the Bible, is said by some authors to be the produce of *Balsamodendron opobalsamum*, Kunth. It is a whitish, viscid, turbid liquid, with an agreeable odour when fresh, thickening and becoming of a yellowish colour by age. Wonderful properties were formerly attributed to it, but its use has become obsolete in Europe. In the East, however, it is still esteemed for its fragrance and medicinal properties. The plant is said to be extinct in India and Egypt, where it formerly grew. The present small supply is obtained from Arabia.

BAL′SAM (bawl′-săm; -sŭm‡§—Knowles, Walker). [Eng., Ger.] *Syn.* BAL′SAMUM (băl′-), L.; BAUME, Fr. Originally, any strong-scented oleo-resinous vegetable juice or exudation, of about the fluidity of treacle, and supposed to possess medicinal virtues. In *modern chemistry* and *pharmacy*, any vegetable production which is either semi-liquid, or which naturally becomes concrete, and which contains either benzoic acid or cinnamic acid, combined with resin and aromatic essential oil. Several of the substances popularly termed balsams contain no benzoic acid, and are consequently now classed with the turpentines. This distinction, however, is far from being universally adopted, and a late high authority defines balsams to be "exudations from plants, which are liquid or soft solid, and consist of a substance resembling a resin, either

combined with benzoic acid, or with an essential oil, or both" (*Brande*).

The leading properties of the true natural balsams are—Insolubility in water, almost entire solubility in alcohol, and partial solubility in ether and in the volatile and fixed oils; the possession of a powerful and, generally, an agreeable odour, a hot, resinous or terebinthinate taste, and the usual stimulant and tonic properties of the milder turpentines. Distilled with water, ethereal oil and some acid pass over, and the residuum consists chiefly or entirely of acid-resin.

The TRUE BALSAMS, as those of benzoin Peru, styrax, and tolu, and the celebrated Chinese varnish-balsam, contain either benzoic or cinnamic acid. Among those falsely termed balsams are Canada, copaiba, opobalsam, Japan lac-varnish, and some of the turpentines.

The following list includes most of the substances, natural and artificial, which pass, or have passed, under the name of balsams:

Balsam, Acous′tic. See DROPS.

Balsam, Amer′ican†. Balsam of Peru.

Balsam, An′odyne. *Syn.* SOOTH′ING BALSAM; BAL′SAMUM ANO′DYNUM (-dĭn-), B. TRANQUIL′LANS, L.; BAUME ANODIN, B. TRANQUILLE, B. TRANQUILLISANT, &c., Fr. *Prep.* 1 (*Bate's*). See PATENT MEDICINES.

2. (*Guy's.*) A vulnerary balsam invented by Guy, of Caliac, once in great repute, but now obsolete. It consisted of aloes, amber, ammoniacum, balsam of Peru, bdellium, caranna, castor, galbanum, labdanum, myrrh, olibanum, styrax, tacamahaca, and Venice turpentine, digested in alcohol.

3. (B. TRANQUILLANS, P. Cod.) Fresh leaves of belladonna, henbane, nightshade, tobacco, poppy, stramonium, of each, 2 oz.; dried leaves of costermary, rosemary, rue, and sage, of each, ½ oz.; dried tops of wormwood, hyssop, sweet marjoram, peppermint, buckbean, and thyme, of each, ½ oz.; flowers of lavender and elder, of each, ½ oz.; olive oil, 50 oz. Heat the green plants in the oil gently until all their water is dissipated; keep on the fire until the oil becomes of a green colour, and whilst still hot, mix in the other plants, carefully dried, and cut up. Digest for twelve hours on a water-bath, strain, and filter.

4. (BAUME TRANQUILLE DE CHOMEL.) Henbane, hound's-tongue, and tobacco, of each, 1 lb.; white wine, 3 pints; boil down to 1 quart; press, strain, and add to the hot 'strained liquor' of olive oil, 1 quart, and again boil.

Balsam of Aniseed (dark):

Oil of anise	10 minims.
„ coriander	6 „
Rectified spirit	½ oz.
Tincture of opium	½ „
Mucilage of acacia	1 „
Paregoric elixir	3 „
Syrup of squills	4 „
Extract of liquorice (liquid)	4 „
Simple syrup to	16 „

Dissolve the oils in the spirit, and add to the extract and mucilage previously mixed; then add the syrup of squills and the rest of the ingredients ('Chemist and Druggist').

Balsam of Acou′chi. A yellowish aromatic liquid, of a terebinthinous nature and consistence, obtained from the wounded branches and shoots of the *Icicia heterophylla* (DC.). It is highly esteemed as vulnerary by the Caribs of Guiana (*Lindley*).

Balsam of Alpi′nus. Balm of Gilead; because Prosper Alpinus wrote a learned (?) treatise on it.

Balsam of Am′ber. *Syn.* BAL′SAMUM SUCCINI, L.; BAUME D'AMBRE, Fr. The article to which this term is usually applied has been already noticed. Oil of amber was also formerly so called; and the same name has been given to the following and other like preparations by their inventors.

1. (*Radius.*) Oil of amber, 4 fl. oz.; oil of myrrh, 2 fl. oz.; oil of turpentine, 1 fl. oz.; mix with a gentle heat.

2. (*Bate.*) See BALSAM ANOYDNE. They are all stimulant and antispasmodic, and are used either internally or as a friction, like oil of amber.

Balsam, Ap′oplexy. *Syn.* BAL′SAMUM APOPLEC′TICUM, B. AD APOPLEC′TICOS (Ph. E., 1744), L. *Prep.* 1. Amber, civet, musk, Peruvian balsam, and some volatile oils, made into a balsam.

2. (Ph. E., 1744.) Expressed oil of nutmeg, 1 oz.; liquefy by a gentle heat, and stir in of the oils of cloves, lavender, and rosemary, of each, ½ dr.; oil of amber, 10 drops; balsam of Peru, 1 dr. Both were formerly used to anoint the head and nostrils of apoplectic patients, and were believed to be of great efficacy.

Balsam of Arcæ′us. *Syn.* BAL′SAMUM ARCÆ′I, L.; BAUME D'ARCÆUS, Fr. A digestive ointment formerly in great repute, and still much employed on the Continent. It is now superseded in England by the comp. elemi ointment of the Pharmacopœias. In the original formula, boiling water, 4 parts, were ordered to be stirred in.

Balsam, Asiat′ic†. Balm of Gilead.

Balsam, Bate's. See BALSAM, ANODYNE.

Balsam, Berlin, for burns, cuts, bruises, and wounds of every kind, sores and ulcers, frost-bites, &c. Chloride of lime with impure glycerine.

Balsam, Bog (*Azorella cæspitosa,* Vahl.; *Bolax glebaria,* Com.). A singular feature in the landscape of the Falkland Islands, forming huge, hard, and perfectly hemispherical hillocks, often 2 feet to 4 feet in height. It yields a gum which has been used in medicine.

Balsam, Brazilian. Balsam of copaiba.

Balsam, Calaba′. *Syn.* TACAMAHA′CA. A fragrant resinous substance produced by *Calophyl′lum cal′aba,* or Santa Maria tree.

Balsam, Cam′phor. *Syn.* CAM′PHORATED BALSAM; BAL′SAMUM CAMPHORA′TUM, &c., L. *Prep.* 1. As camphor liniment, P. B.

2. (B. ACE′TICUM C., Sanchez's GOUT-B.:—*Pelletier.*) Curd-soap and camphor, of each, 5 dr.; oil of thyme, 2 scr.; acetic ether, 5 oz.; digest together in a stoppered bottle until the solids are dissolved. Recommended as an efficacious anodyne liniment in certain forms of rheumatism and gout.

Balsam, Can′ada. From the balsam fir (*Pinus balsamea,* Linn.), a tree, twenty to forty feet high,

native of cold and swampy districts of Labrador, Nova Scotia, and other parts of Canada. Canadian balsam is contained in receptacles in or under the bark, in the same manner as Strassburg turpentine, and it is collected by piercing these receptacles with a long iron tube sharpened at the point and terminated at the bottom with a small can, into which it trickles as the cells are punctured. A large tree will yield about a pound of balsam; the average yield, however, is about 8 oz. The collection is carried on during the months of June, July, and August, and it is principally obtained in Lower Canada and exported from Quebec and Montreal in kegs or large barrels. In the Northern United States it is also furnished by *Abies Fraseri*, Pursh. The properties of Canada balsam are similar to those of other turpentines, and it is but little employed in medicine at the present time. It is, however, used for mounting microscopic objects as well as by varnish makers and by opticians as a cement.

Balsam, Cana′ry. A volatile oleaginous substance obtained by distillation from *Dracocephʹalum Moldaviʹcum.*

Balsam, Carpa′thian. Riga balsam.

Balsam, Cephal′ic (Saxon). *Syn.* Bal′samum cephali′cum Saxoni′cum, L. A liquid preparation obtained from the essential oils of amber, lavender, marjoram, nutmeg, pennyroyal, rue, sage, &c., distilled together. Once in high repute, but long disused in England.

Balsam, Chil′blain. See Liniments.

Balsam, Chi′na Varnish. The aromatic varnish-like exudation of *Au′gia sinen′sis,* used by the Chinese as a varnish or lacquer, for which purpose it is, perhaps, unequalled. It is highly fragrant, and abounds in benzoic acid.

Balsam of Cloves. *Syn.* Aromat′ic balsam of cloves; Bal′samum caryophyl′li, L. *Prep.* (*Bories.*) Oil of cloves and oil of nutmeg, of each, ½ dr.; spirit of juniper berries, 3 oz,; mix. Rubefacient and diuretic. Used chiefly as a stimulating friction. *Internally,* ½ to 1 teaspoonful.

Balsam, Command′er's†. Compound tincture of benzoin.

Balsam of Copai′ba. See Copaiba.

Balsam, Copalm′. Liquidambar.

Balsam, Egyptian. Balm of Mecca.

Balsam, Eye, Augsburg. Red oxide of mercury, ·75 grm.; extract of belladonna, ·5 grm.; tincture of opium, ·5 grm.; fatty substance, 7 grms. (*Hager*).

Balsam, Eye (*Müller,* Berlin). Red oxide of mercury, 5 parts; opium, 3 parts; unsalted butter, 100 parts.

Balsam, Eye (*Müller's* Widow, Berlin). Red oxide of mercury, ·2 grm.; unsalted, unusually rancid, butter, 10 grms.

Balsam, Fe′male. *Syn.* Bal′samum embryo′num, A′qua e., L. An obsolete preparation made by digesting mistletoe, civet, musk, and several other aromatics, in a mixture of wine and various medicated waters, and submitting the whole to distillation. Formerly taken both internally and externally, as a tonic for both fœtus and mother; and particularly to prevent abortion, &c.

Balsam of Fern. Oil of male fern.

Balsam of Fiovaren′ti. *Syn.* Bal′samum Fiovaren′ti, L. *Prep.* (P. Cod.) Venice turpentine, 16 oz.; amber, elemi, galbanum, myrrh, styrax, and tacamahaca, of each, 3 oz.; aloes, 1 oz.; bayberries, 4 oz.; cinnamon, cloves, galangal, ginger, nutmegs, and zedoary, of each, 1½ oz.; dittany of Crete, 1 oz.; rectified spirit, 8 lbs.; macerate a week and distil off 7 lbs. The distilled spirit constitutes this notable preparation of, professedly, many virtues. It is reputed aromatic, diuretic, antispasmodic, and stimulant. One of its applications is as a collyrium—a drop or two being rubbed on the palm of the hands, which are then held to the eyes, so as to cover, without touching them—in chronic ophthalmia, conjunctivitis, &c.

Balsam, Fri′ar's. Compound tincture of benzoin.

Balsam, Geno′a. Locatelle's balsam.

Balsam of Gil′ead. See Balsam of Mecca.

Balsam, Glyc′erin (glĭs′-). *Syn.* Bal′samum glyceri′næ, L. *Prep.* To white wax and spermaceti, of each, 1 *oz.;* almond oil, ½ *lb.;* melted together, add of glycerin, 2 *oz.;* balsam of Peru, ½ *oz.;* and stir or agitate until nearly cold. 12 or 15 drops of otto of roses may be substituted for the balsam. Used to soften and whiten the skin, and to prevent chaps and chilblains.

Balsam, God′bold's Vegetable. See Patent Medicines.

Balsam, Goulard's. *Syn.* Bal′samum Goular′dii, B. satur′ni, L.; Baume de Goulard, Fr. *Prep.* (*Van Mons.*) Acetate of lead (in fine powder, and quite dry) is triturated, for some time, with hot oil of turpentine, in a heated mortar, or until no more will dissolve; after repose, and whilst still hot, the clear portion is decanted. Recommended as a useful application to foul and painful ulcers, and to scalds and burns.

Balsam, Green. *Syn.* Bal′samum vir′ide, &c., L.; Baume vert, Fr. *Prep.* 1. Linseed oil, 6 lbs.; gum elemi, 1 lb.; heat them together; add of powdered verdigris, 3 oz., or q. s. to impart a rich green colour, and, after repose, decant the clear portion.

2. Linseed oil strongly coloured with verdigris. Both were formerly much used by surgeons as detergents. 'Green oil' or 'oil of elder leaves' is now commonly sold for it.

A natural balsam, brought from Peru, and produced by *Chlorox′ylon verticilla′tum,* is also popularly called green balsam (of Peru).

Balsam of Gua′iacum (gwā-yă-). *Syn.* Bal′samum guai′aci, B. guaiaci′num, L. *Prep.* (Ph. L. 1745.) Resin of guaiacum, 1 lb.; balsam of Peru, 3 dr.; rectified spirit, 1 quart; digest 10 days and filter. Diaphoretic, arthrodynic, and anodyne.—*Dose,* 30 to 60 drops, in milk or water; in agues, rheumatism, &c. *Externally,* reputed also anti-suppurative.

Balsam, Gurgun′ (-gōōn′). *Syn.* Gurgi′na balsam, Wood oil (of India). From *Dipterocarpus lævis,* and other species, by applying a slow fire to a notch or wound made in the trunk. It is an oleo-resin of the consistence of olive oil, lighter than water, and slightly fluorescent. Heated to 132° C. it becomes turbid and gelatinous.

Use. As a local application in eczema; also, mixed with 3 parts of lime water, to anoint the body in leprosy.

Balsam, Hill's, of Honey. See PATENT MEDICINES.

Balsam of Honey. *Syn.* PECTORAL BALSAM, P. B. OF HONEY; BAL'SAMUM MEL'LIS, B. PECTORA'LE B. P. MELLIS, L.; BAUME DE MIEL, &c., Fr. *Prep.* 1. Balsam of tolu, 1 lb.; honey (finest), $2\frac{1}{2}$ lbs.; rectified spirit, 1 gall.; turmeric, 1 oz.; make a tincture.

2. To the last, before maceration, add of powdered opium, 2 oz.

Uses, &c. A good pectoral in colds, tickling chronic coughs, hoarseness, &c., when unaccompanied with fever.—*Dose.* For an adult $\frac{1}{2}$ to 1 teaspoonful, twice or thrice a day; an occasional dose of some mild aperient being also taken. Tincture of balsam of tolu, or a mixture of the tinctures of tolu and benzoin, is frequently sold in the shops under the name of 'balsam of honey.' See PECTORAL BALSAM, &c.

Balsam of Hore'hound. *Syn.* BAL'SAMUM MARRU'BII, L. *Prep.* 1. Extracts of horehound and liquorice, of each, 2 oz.; hot water, $\frac{1}{2}$ pint; dissolve, and when cold, add of paregoric, $\frac{3}{4}$ pint; oxymel of squills, 6 oz.; tincture of benzoin, 2 oz.; honey 10 oz.; and, after thorough admixture, strain through flannel.

2. (*Ford's.*) See PATENT MEDICINES.

Uses, &c. A popular pectoral.—*Dose, &c.*, same as of BALSAM OF HONEY (*above*).

Balsam of Houmi''ri. [Nat.] From *Humir'ia balsamif'era*, or the houmiri-tree of Guiana. It resembles 'balsam of umiri' produced by another tree of the same genus (see *below*).

Balsam, Hungarian. *Syn.* BAL'SAMUM HUNGAR'ICUM, L. A terebinthinate exudation from the extremities of the branches of *Pi'nus pumil'io*, Willd., or mountain pine. It is also obtained by pressure from the 'cones' of the same tree.

Balsam, Ioduretted. See LINIMENTS.

Balsam, Japan Varnish. *Syn.* JAPAN LACQ'UER. Exudes from incisions made in the trunk of *Melanorrhœ'a usitatis'sima*, according to Wallich; or *Stagma''ria avernicif'lua*, according to Lindley. It constitutes the celebrated lac-varnish of the Japanese. It differs from that of China, and from the true balsams, in not containing benzoic acid. It is extremely acrid and irritant; and even its fumes affect the eyes and respiration.

Balsam†, Jew's. Balm of Gilead.

Balsam of Lead. See BALSAM, GOULARD'S.

Balsam of Life. *Syn.* BALM OF LIFE; BAL'SAMUM VI'TÆ, L.; BAUME DE VIE, ELIX'IR DE VIE, &c., Fr. Several compound medicines have been called by this name. Those of Gabius, Hoffman, and Turlington, are noticed under PATENT MEDICINES (which *see*). The following are distinct preparations:

1. BAUME DE VIE EXTERNE:—Soap liniment, 2 parts; oil of turpentine, 1 part; mix. Stimulant and rubefacient. Used with friction.

2. BAUME DE VIE PURGATIF; Elixir de vie:—*a.* (*Briett.*) Socotrine aloes and saffron, of each, 2 drs.; rhubarb, 6 drs.; liquorice-root, 1 oz.; proof spirit or brandy, $\frac{1}{2}$ pint; digest a week, and filter.

b. (Original Swedish formula.) Aloes, 9 drs.; agaric, gentian, rhubarb, saffron, theriaca, and zedoary, of each, 1 dr.; proof spirit or brandy, 1 quart. A mild stomachic purge.—*Dose,* 1 to 6 dr. Tincture of rhubarb-and-aloes (Ph. E.) is commonly substituted for it. See ELIXIRS.

Balsam of Life, Professor Cook's. Recommended especially for toothache and skin diseases. Borax, 20 parts; boiling water, 250 parts; camphor, $1\frac{1}{2}$ part (*Hager*).

Balsam of Liq'uorice. See PATENT MEDICINES.

Balsam, Locatelle's'. *Syn.* LOCATEL'LI'S BALSAM; BAL'SAMUM LOCATEL'LI, B. LUCATEL'LI, B. ITAL'ICUM, B. GENOFE'VÆ, &c., L. var. *Prep.* 1. (Original formula.) Olive oil, 6 oz.; yellow wax, 4 oz.; sherry wine, 5 fl. oz.; red sanders (in very fine powder), 4 dr.; simmer them together until the moisture is nearly evaporated, then add of Strasburg turpentine, 6 oz.; balsam of Peru, 2 dr.; strain through linen, and stir until nearly cold.

2. (Ph. E. 1744.) Olive oil, 24 fl. oz.; yellow wax, 1 lb.; melt, and add of Venice turpentine, $1\frac{1}{2}$ lb.; and, when cooled a little, further add, powdered dragon's blood, 1 oz.; balsam of Peru, 2 oz.; and stir until cold.

3. (Ph. L. 1746.) Olive oil, 16 fl. oz.; Venice turpentine and yellow wax, of each, $\frac{1}{2}$ lb.; red sanders, 6 dr.

Uses, &c. A once highly esteemed pectoral, and still occasionally used, by the lower classes, in phthisis and chronic coughs (mixed with an equal weight of conserve of roses), and as a mild stimulating ointment.—*Dose,* $\frac{1}{2}$ dr. or more.

Balsam of Mec'ca. *Syn.* BALM OF GIL'EAD, B. OF MEC'CA, OPOBAL'SAM (-bawl'-), JEWS' BALSAM†, OIL OF B.†, &c., Eng.; BAL'SAMUM (băl'-) GILEADEN'SE, B. È MEC'CA, OPOBAL'SAMUM (-băl'-), &c., L.; BAUME DE LA MECQUE, B. DE MECCA*, B. DE JUDÉE, OPOBALSAMUM, &c., Fr.; BAL'SAMUM ÆGYPTI'ACUM†, B. ALPI'NI, B. ANTIQUO''RUM GENUI'NUM†, B. ASIAT'ICUM†, B. SYRI'ACUM†, O'LEUM BAL'SAMI†, &c., L. A fragrant oleo-resinous substance, obtained from *Balsamoden'dron gileaden'se*, Kunth. (*Amy'ris gileaden'sis*, Linn.; *A. opobal'samum*, Forsk), a middle-sized tree of the Nat. Ord. TEREBINTHACEÆ (DC.), growing in Arabia Felix, Asia Minor, and Egypt. It is the BALM of the Old Testament, and the βάλσαμον of Theophrastus and Dioscorides. It is chemically classed with the turpentines.

Prop., &c. When fresh it is turbid and whitish, but becomes by degrees transparent, of a rich golden colour, and slightly thicker; and by exposure, eventually solid. It possesses a penetrating and delicate fragrance; tastes sharp, bitter, spicy, and somewhat astringent; is not entirely soluble in rectified spirit, but dissolves more or less completely in both the fixed and volatile oils, which then assume the fragrance of the balsam. A drop let fall on hot water spreads itself over the whole surface, like a film of oil, and again contracts on the water cooling. This, with its fragrance, is the common test of its genuineness in Turkey. The inferior qualities, or those of commerce, are generally opaque and thick, rapidly becoming resinous and turning of a dull yellow by age. When applied to the skin it causes redness and swelling. It was formerly regarded as possessing the most varied and exalted virtues, par-

ticularly as an antiseptic, stimulant, vulnerary, and nervine; and its fumes were supposed to prevent barrenness. It is still highly prized in the East as a cosmetic and perfume; and is said to be unequalled for giving a healthy glow to the complexion and promoting the growth of the hair. Its medicinal qualities are intermediate to those of the aromatic turpentines and balsam of tolu.—*Dose.* From 3 to 6, or even 10 to 12 drops.

Obs. According to Bruce and others, the best balm of Gilead is a spontaneous exudation from the tree; a second quality is obtained by cutting the bark with an axe, and receiving the juice which exudes in a small earthen bottle. A large branch is said to produce not more than 3 or 4 drops a day; and even the most resinous trees seldom yield more than 60 drops daily. Hence its scarcity and costliness. Both varieties are held in such high estimation by the Turks and Egyptians, that none of them are exported as an article of commerce. That which is sent to England is obtained by boiling the leaves and young twigs of the balsam tree in water, and is rejected by the Orientals as worthless. Most of that sold in the shops of England is entirely spurious (see *below*).

The cosmetics advertised as 'BALM OF MECCA' do not even contain a trace of this article; nor do we believe that there is a single drop of the genuine balm to be purchased in London.

The following formulæ are current in the trade for **Facti″tious Balm of Mecca**:

1. Gum-benzoin (bright, coarsely powdered), 4 *oz.;* liquid styrax (finest), 3 *oz.;* balsam of tolu, 2 *oz.;* Canadian balsam, 1½ pint, are mixed together in a flask, and exposed (closed) to the heat of a water-bath, with frequent agitation, until the liquid is saturated; when cold, the clear portion is decanted, and a sufficient quantity of the oils of lemon, cassia, rosemary, nutmeg, and vanilla added to give it a strong aromatic odour.

2. From gum-benzoin and balsam of Peru, of each, 1 *oz.;* vanilla and nutmeg, of each (cut small), 1 *dr.;* Canadian balsam, ½ pint; digested as before, and some essential oils added to the decanted liquid.

Balsam, Mercu″rial†. Ointment of nitrate of mercury.

Balsam, Metz's. *Syn.* BAL'SAMUM VIR'IDE METEN'SIUM, L.; BAUME VERT DE METZ, Fr. *Prep.* (*Guibourt*). Linseed oil and olive oil, of each, 6 oz.; oil of laurel berries, 1 oz.; common turpentine, 2 oz.; melt by a gentle heat, and add of verdigris, 3 dr.; aloes, 2 dr.; sulphate of zinc, 1½ dr. (all in powder); mix well, strain or pour the liquid into a bottle, and add oil of juniper, 4 dr.; oil of cloves, 1 dr. Used on the Continent as a common detergent dressing to wounds and ulcers.

Balsam, Mex'ican†. Balsam of Peru.

Balsam, Nat'ural†. That which exudes from plants, as opposed to those formed by art.

Balsam, Ner'vine. See OINTMENTS.

Balsam of Nutmeg. *Syn.* BAL'SAMUM MYRIS'TICÆ, B. NUCIS'TÆ, L. *Prep.* (Ph. Bor. 1847). Expressed oil of nutmeg (—? mace), 3 *oz.;* olive oil, 1 *oz.;* yellow wax, ½ *oz.;* melt them together by a gentle heat, pour the mixture into paper moulds, and, when cold, cut the mass up into cakes.

Balsam, Odontal'gic. See DROPS.

Balsam, Opodel'doc. See OPODELDOC (*French*).

Balsam, Pec'toral. *Syn.* BAL'SAMUM PECTORA'LE, L.; BAUME PECTORAL, Fr. *Prep.* 1. Tincture of tolu and compound tincture of benzoin, of each, 2 oz.; rectified spirit, 4 oz.; mix. —*Dose,* ½ to 1 teaspoonful, night and morning; in chronic coughs, hoarseness, &c.

2, 3. See BALSAM OF HONEY, B. OF HOREHOUND, &c.

Balsam, Persian†. Friar's balsam.

Balsam of Peru' (rōō'). *Syn.* PERU'VIAN BALSAM; BAL'SAMUM PERUVIA'NUM (Ph. B.), L.; BAUME DU PÉROU, B. PERUVIEN, Fr.; PERUVIANISCHER BALSAM, Ger. A balsam obtained from *Myroxylon Pereiræ* (*Myrospermum of Sonsonate*), *Toluifera Pereiræ,* Baill. (*Myrospermum Pereiræ,* Royle), a spreading tree about 50 feet high, found in woods on the Sonsonate coast, San Salvador, Central America. To collect the balsam the bark is beaten and removed, heat is then applied to the bared portion of the trunk, which is covered with cloths. These when saturated with balsam are boiled in water for some time, the cloths being finally wrung by two men in a rope press. By this means very little of the balsam is wasted. When it is cooled, the water is poured off and the balsam transferred to the canisters for exportation.

Prop., &c. A chocolate-coloured or a reddish-brown liquid, of the consistence of treacle, possessing a bitterish, rather pungent taste, and an agreeable aromatic odour somewhat similar to that of a mixture of vanilla and benzoin. It is reputed stimulant, antiseptic, tonic, and expectorant, and has long been a popular remedy in chronic asthma, catarrh, and other pulmonary affections, debility, &c. It is now, however, principally used as an ingredient in pomades, hair oils, lip salves, and other cosmetics, in which it is only inferior to 'balm of Mecca;' and in compound perfumery. It is also used to scent lozenges, pastils, and chocolate and liqueurs; for these last, chiefly as a substitute for 'vanilla' when it is scarce and dear.—*Dose,* 10 or 12 to 30 gr. (even 1 dr. is sometimes given), either on sugar, or made into a bolus with liquorice powder, or into an emulsion with honey, mucilage, or yelk of egg.

Pur., Tests, &c. 1. Ether dissolves it readily. 2. Soluble in an equal volume of rectified spirit. 3. Should not lessen in volume when shaken with water. 4. Treated with nitric acid, some hydrocyanic acid is formed, benzoic acid sublimes, and the residual matter is artificial tannin. 5. The alkalies and their carbonates form with it a thickish semi-crystalline mass, which, on being treated with sulphuric acid, deposits a peculiar resinous matter, with crystals of benzoic and cinnamic acid. 6. If a few drops are distilled, and iodine added to the distillate, an explosion results, it has been adulterated with 'copaiba.' 7. The genuine balsam contains about 6½% of benzoic (cinnamic) acid. 8. (*Hager.*) If two or three cubic centimetres of balsam of Peru be shaken with five or six cubic centimetres of petroleum spirit, the mixture separates upon being allowed to stand into a black-brown layer, and a limpid and colourless or slightly yellowish layer, and is easily decanted. If the balsam be

adulterated, this latter layer is turbid and coloured, while the viscous residue which separates is more fluid, which renders decantation more difficult. Sometimes the brown residue is pulverulent.

The following tests for the balsam are given by P. MacEwan ('Year-book of Pharmacy,' 1884):

(*a*) *Specific Gravity.* 1·137 to 1·150 at 15·5° C.

(*b*) *Sulphuric Acid Test.* One volume rubbed in a mortar with two volumes sulphuric acid should, when washed with cold water, form a brittle resinous mass. If fixed oil is present the mass does not harden.

(*c*) *Ammonia Test.* Originated by Dr C. Grote. Five drops of balsam shaken up with 3 c.c. of solution of ammonia should give very little froth, and should not gelatinise in twenty-four hours. This test detects common resin or colophony, for which purpose it is well suited.

(*d*) *Determination of Cinnamein.* One part of balsam is treated with 5 parts of petroleum ether. The ether solution is removed and the oily residue weighed. The yield should be from 40% to 48%.

(*e*) *Determination of Resin.* Shake 1 part by weight of the balsam with 3 parts of bisulphide of carbon, 86% to 90% should dissolve, whilst 10% to 14% of resin remains insoluble. The presence of benzoin increases the yield of resin.

Obs. Balsam of Peru was formerly very generally adulterated, and often entirely factitious; but, owing to its present reduced price, this is now only confined to a few of the most unprincipled vendors. The following formulæ for this purpose are still extant in the trade:

Balsam of Peru, Facti′′tious. From gum-benzoin (in coarse powder), 3 *lbs.*; dissolved in the least possible quantity of rectified spirit, and then mixed with balsam of Tolu, 1 *lb.*; and liquid styrax, 2 *oz.*; subsequently adding of rectified spirit, q. s.

Balsam, Peru′′vian. See BALSAM OF PERU.

Balsam, Pol′ychrest. *Syn.* ELIXIR POLYCHRESTON. (E. 1745.) Guaiacum, 6 oz.; balsam of Peru, ½ oz.; rectified spirit, 32 oz. Digest in a sand-bath for four days, and add oil of sassafras, 2 dr.

Balsam of Rackasi′ri. *Syn.* BALSAM OF RAKASI′RA; BAL′SAMUM RACKASIRI, B. RACAZZI′RÆ, B. RHADASI′RI. A species of balsamic turpentine, said to be obtained from the *Bursera balsamifera* (Pers.), an Indian tree of the Nat. Ord. TEREBINTHACEÆ. It has a slightly bitter taste, adheres to the teeth when chewed, and, when heated, smells like balsam of Tolu. It has been extolled as possessing the virtues of copaiba in an exalted degree. The nostrum vended under the name of BALM OF RACKASIRI by certain quacks simply consists of English gin, coloured, sweetened, and aromatised.

Balsam, Reduced Peruvian. 1. Balsam of Peru, 3 *lbs.*; balsam of Tolu, 2 *lbs.*; rectified spirit, q. s. to reduce it to a proper consistence. 2. Balsam of Peru, 3 *lbs.*; gum-benzoin (dissolved in a little rectified spirit), 1 *lb*; as before. It is occasionally met with largely adulterated with liquid styrax.

Balsam, Riga (rē′-). *Syn.* CARPA′THINA BALSAM; BAL′SAMUM CARPATH′ICUM, B. LIB′ANI, &c., L.; BAUME DE CARPATHES, Fr. A pellucid white fluid obtained by careful distillation from the young shoots of *Pi′nus cem′bra*, Linn., or Siberian stone-pine. It much resembles oil of juniper; and, like that article, is powerfully diuretic. It is regarded as vulnerary, and is highly esteemed by some in sprains and bruises. The bottoms of oil of juniper are commonly sold for it in the shops. The spirit distilled from pine-tops (*Spiritus turionum pini*) is also frequently, although incorrectly, called RIGA BALSAM.

The following is the formula which is generally followed on the Continent:

Aquæ aromaticæ . . .	30 parts.
Spiritus salviæ . . .	10 „
Tincturæ croci . . .	1 part.

—all by weight.

Balsam, Sanchez's Gout. See BALSAM, CAMPHORATED.

Balsam, Saturnine (*Bate*). Acetate of lead, 40 *oz.*; oil of turpentine, 12 *oz.* Digest for some days.

Balsam of Soap. Soap liniment.

Balsam of Soap (Ethe′′real). *Syn.* BAL′SAMUM SAPO′NIS ÆTHE′′REUM, L. *Prep.* (*Cottereau.*) Castile soap (powdered) and camphor, of each, 1 dr.; oil of thyme, 10 drops; acetic ether, 1 oz.; dissolve in a close vessel with the aid of a gentle heat, and decant the clear portion. Used as an embrocation or liniment in gout, rheumatism, &c.

Balsam, Sooth′ing. See BALSAM, ANODYNE.

Balsam, St Genevieve. Thick turpentine, 5 parts; olive oil, 30 parts; beeswax, 25 parts; spermaceti, 5 parts; camphor, 1 part; red sanders, 4 parts.

Balsam, St John Long's (liniment), used for application to the chest in cases of phthisis, is a thick emulsion composed of turpentine, 25 parts; yolk of eggs, 50 parts; concentrated vinegar, 5 parts; rose water, 15 parts; and a few drops of essence of lemon.

Balsam of St John's-wort. See OILS.

Balsam, Stomach′ic (-măk′-). *Syn.* BAL′SAMUM STOMACH′ICUM, L.; BAUME STOMACHIQUE, Fr. *Prep.* (Ph. Slesv.-Hols. 1831.) Oil of cloves, mace, wormwood, and peppermint, of each, 1 dr.; balsam of Peru, 2 dr.; oil of nutmeg, 2 oz.; mix. 1 to 5 or 6 drops, on sugar, or dissolved in spirit.

Balsam of Sto′′rax. Liquidambar or styrax.

Balsam of Sul′phur. See OILS.

Balsam of Sul′phur, Anisated (Ph. Edin. 1722). Originally made by digesting 1 part of sulphur; 3 of turpentine; and 4 of oil of aniseed. A mixture of 1 part of oil of aniseed with 3 or 4 of balsam of sulphur is usually sold for it.

Balsam of Sul′phur with Turpentine. Digest 1 part of sulphur with 3 of oil of turpentine till dissolved. Similar compounds were formerly made with sulphur and Barbadoes tar, and with the empyreumatic oils of amber, benzoin, &c.

Balsam of Syri′acum. See BALSAM OF MECCA.

Balsam, Syr′ian. Balsam of Mecca.

Balsam, Thibaut's. See PATENT MEDICINES.

Balsam of Tolu′ (-lōō′). *Syn.* TOLU′ BAL′SAM*; BAL′SAMUM TOLUTA′NUM (Ph. L., E., & D.), B. DE TO′LŪ, L.; BAUME DE TOLU, Fr.; TOLU-

TANISCHER BALSAM, B. VON TOLU, &c., Ger., furnished by *Toluifera balsamum*, L. (*Myroxylon Toluifera*, H. B. K.). The tree, which grows to a height of 80 feet, is often unbranched for a distance of 40 to 60 feet from the ground. It is a native of Venezuela and New Grenada, where the balsam is collected by making V-shaped incisions through the bark to the wood of the growing tree, and inserting cups made of calabashes. The balsam is finally put into cylindrical tins for exportation to Europe.

Prop., Uses, &c. When first brought over it is soft and tenacious, but by age and careless keeping becomes hard, and even brittle, somewhat similar to resin. It is perfectly soluble in alcohol and in ether, and gives out its acid (benzoic or cinnamic) to water. Its odour is fragrant, though less powerful than that of either styrax or balsam of Peru; and it has a pleasant, sweetish taste. It softens under the teeth, melts readily, and burns with an agreeable odour. A small piece pressed between two pieces of glass and examined by a lens exhibits crystals of cinnamic acid. As a medicine it is a stimulating expectorant, and, as such, is employed in chronic bronchial affections unaccompanied with inflammatory action. It has long been a popular pectoral. Syrup of Tolu is an agreeable and common adjunct to pectoral mixtures, and, with Tolu lozenges, is often serviceable in tickling coughs. It is also used by confectioners, perfumers, &c., and in fumigating pastils.—*Dose*, 5 to 20, or even 30 gr., dissolved in spirit, or made into an emulsion.

Pur. This is shown by its perfect solubility in rectified spirit, forming a transparent tincture, and by its odour. When adulterated it has a weaker smell, is only partially soluble in alcohol, and the tincture formed with that fluid is opaque. The presence of colophony (or lac), according to Ulex, may be detected by the balsam, instead of dissolving in sulphuric acid, swelling up, blackening, and disengaging sulphurous fumes 'Archiv der Pharm.,' 1855). Castor oil may be detected in the way noticed under BALSAM OF PERU.

Balsam of Tolu, a Factitious, was formerly met with in trade, made of equal parts of orange-lac and white sugar, reduced to a proper consistence with rectified spirit, and 'brought up' with some tincture of benzoin and a few drops of the oil of cassia and nutmeg dissolved in a little essence of vanilla.

Balsam, Tooth'ache. See DROPS, &c.

Balsam, Traumat'ic. Compound tincture of benzoin.

Balsam, Tur'key. *Syn.* TUR'KEY BALM. The distilled oil of the *Dracocephalum Moldavicum.*

Balsam, Tur'lington's. See PATENT MEDICINES.

Balsam of Tur'pentine (-tīne). *Syn.* BAL'SAMUM TEREBIN'THINÆ, L. A name formerly given to Strasburg, Venice, and other like turpentines.

Balsam of Turpentine (Emollient). *Syn.* B. TEREBINTHINA'TUM, L. *Prep.* Olive oil, 6 oz.; oil of turpentine, 2 oz.; yellow wax, 1 oz.; balsam of Peru, oil of nutmeg, and camphor, of each, 2 dr. A stimulant emollient; in contusions, ulcerations, engorgements, nephritic pains, &c.

Balsam of Umi''ri. [Nat.] By incision, from the *Humir'ia floribund'um*, Mart., or the *umiri-plant* of Para. It is fragrant, limpid, of a palish-yellow colour, and in its medicinal properties is said to combine those of the balsams of copaiba and Peru.

Balsam, Univer'sal. *Syn.* BAL'SAMUM UNIVERSA'LE, L. *Prep.* (Ph. Slesv.-Hols. 1831). Rape oil, (recent), 1½ lb.; yellow wax, ½ lb.; acetate of lead (in fine powder), 3 oz.; powdered camphor, ½ oz.; melted together; observing to triturate the acetate with a small portion of the oil before adding it to the mixture, and not to add the camphor until the heat is reduced a little. *Obs.* This name has also been given to 'compound cerate of lead,' and even to 'cerate of acetate of lead.'

Balsam, Vervain's†. Compound tincture of benzoin.

Balsam, Wound. Several vulnerary preparations have been so called, but FRIAR'S BALSAM (comp. tinct. of benzoin) is that usually intended.

BALSAM'IC (băl-). *Syn.* BALSAM'ICUS, BALSA'MEUS, BALSAM'INUS, L.; BALSAMIQUE, Fr.; BALSAMISCH, Ger. Of the nature of balsam, or containing or resembling it; bland, soothing, healing; balmy.

BAMBOO' (bōō'). [Nat.] *Syn.* BAMBU'SA, L.; BAMBON, Fr.; BAMBUS, BAMBUSROHR, INDIANISCHER ROHR, Ger. The name of several species of the genus *Bambusa*, but appr. of *B. arundina'cea*, or 'common bamboo.' See BAMBUSA.

Bamboo'-habit (-hăb-). A species of 'life-preserver,' or 'float,' used in China and the Indian Archipelago, consisting of four pieces of bamboo tied together so as to form a square.

BAMBU'SA (Endl.). The bamboo. In *botany*, a genus of magnificent arborescent grasses, of the Nat. Ord. GRAMINEÆ (DC.), having hollow jointed stems, of a hard woody texture, externally coated with siliceous matter, and sometimes secreting a similar siliceous substance (TABASHEER') in their internal cavities. They are all of rapid growth, and vary in height from 6 to 50 feet.

There is, perhaps, scarcely any other plant besides the palm which serves for so many purposes useful to man, as the various species of bamboo. Its grain is used for bread; the young shoots are eaten like asparagus, and are also pickled; the smaller stalks are made into walking canes, umbrella and parasol sticks, flutes, &c.; whilst its fibres are manufactured into cloth, and even paper. It is employed extensively in the construction of houses, bridges, masts for boats, domestic furniture, boxes, mats, baskets, utensils of various kinds, fences, water-pipes and vessels, quicksilver bottles, &c., and for numerous other purposes connected with everyday life. In localities where ordinary surgical appliances are not at hand, splints, of any required length or size, can be made with very little delay, from the stems of the bamboo. The older and drier stems are to be preferred for this purpose. Roughly speaking, the kinds met with in commerce may be specified as black, brown, yellow, mottled, mahogany, and spotted, according to colour and marking. All the colours are merely approximate, as different sticks, or to speak technically, canes, in a bundle vary considerably. The artificially

coloured canes, such as black and mahogany, of course are more uniform than those which are left in their natural state, if we except, perhaps, the yellow variety. In addition to the plain stained canes, there are some such as the tortoise-shell with fancy mottling produced by artificial means. All the kinds are obtainable either with or without roots, the rooted canes being the dearer of the two. The sizes of the canes vary considerably, the thickness being from $\frac{1}{8}$ in. to 3 in. or more, those most useful for furniture of the fancy kind being from $\frac{1}{2}$ in. or $\frac{5}{8}$ in. to 2 in. In length they are from $3\frac{1}{2}$ ft., the thinner canes up to say $\frac{5}{8}$ in. thick not exceeding this, while the thicker ones are cut in 6 ft. and 13 ft. lengths. Other sizes are also to be met with, but those named are among the most common. One variety of small canes known as Tonkings should not be omitted. The genus is confined to the East and West Indies and Tropical America. See CANE, PICKLES, TABASHEER, &c.

BANA'NA (-nā'- or -nah'-). [Nat.] The *Mu'sa sapien'tum*, Linn., a species of plantain; also its fruit. The banana contains about 27% of solid matter, and has nearly the same nutritive value as rice. It is largely consumed in the tropics, where the common allowance for a labourer is $6\frac{1}{2}$ lbs. of the fresh fruit or 2 lbs. of the dry meal, with $\frac{1}{4}$ lb. of salt meat or fish. It is sometimes fried in slices and often made into preserves.

Composition of the Pulp of Ripe Bananas (CORENWINDER).

Nitrogenous matter	4·820
Sugar, pectose, organic acid, and traces of starch	19·657
Fatty matter	0·632
Cellulose	0·200
Saline matter	0·791
Water	73·900
	100·000

See PLANTAIN.

BANCOUL, NUTS OF. This nut is the seed of a tree belonging to the EUPHORBIACEÆ, of which two or three species occur in Ceylon, Cochin-China, New Caledonia, Bourbon, &c. It is composed of a hard and woody endocarp, and of an oily kernel, containing:

Water	5·000
Oil	62·175
Nitrogenous matter	22·653
Non-nitrogenous matter	6·827
Mineral matter	3·345
	100·000
Nitrogen	3·625%

This cake, after expression of the oil, contains 9% of nitrogen, and 4% of phosphoric acid, and is consequently of high value as a manure. The expressed oil is purgative, and as a lamp-oil it is superior to colza. Unfortunately the kernel forms only 33% of the entire weight of the nut. Hence, before it can become an article of commerce, it must be decorticated at the place of its birth (*Corenwinder*).

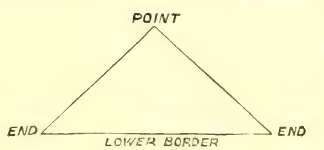
BAND'AGE (-āje). *Syn.* DELIGA'TIO, FAS''CIA, LIGA'MEN, LIGATU''RA, VINCTU''RA, L.; BANDAGE, BANDE, Fr.; BINDE, VERBAND, Ger. In *surgery*, the fillet, roller, or cloths used to support parts, to exert pressure on them, or to retain dressings in their proper places.

The uses of bandages are to afford support to different parts of the body when injured, to keep the dressings of wounds in their place, to fix and maintain splints in their proper position, and to prevent the muscular movements of the patient from injuriously affecting injured parts; they are also used to apply pressure for stopping hæmorrhage, and to protect wounds from dirt and dust and the attacks of flies and other insects.

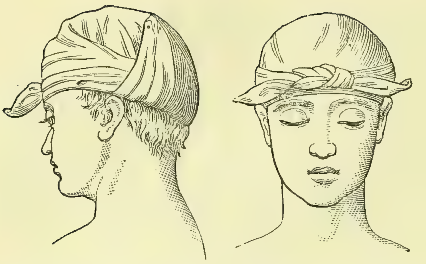
For the purposes of first aid to the injured in those cases in which skilled assistance is not at hand, two forms of bandage are most generally used, viz. the roller, and the Esmarch triangular bandage.

Roller bandages are made of unbleached calico, linen, flannel, or any other suitable material. Their length and breadth is adjusted to the purpose for which they are required. The most generally useful size is six yards long and three fingers broad; for the chest, one or two six inches broad and three yards long; for fingers, bandages one yard long and half inch to three-quarter inch wide will be most useful. Half a dozen bandages made of new unbleached calico, rather stout than otherwise, are always useful in any household, and especially in those in which the members of it are exposed to the risk of accidents from machinery, edge tools, &c., as in workshops and farmhouses. It must be remembered that a bandage is not merely a piece of material tied over an injured part, but that it has to serve a distinct and definite purpose; and further, that if improperly applied, it may not only be useless but productive of positive harm, and as it is possible through the medium of some of the many ambulance associations now in existence to obtain properly made bandages and concise directions for applying them, it is possible for almost any one to possess a certain amount of knowledge of the art of bandaging.

Esmarch's triangular bandage is made by taking a piece of linen or calico about forty inches square, and cutting it diagonally into halves. This can be folded into a very small compass and carried in the pocket. As an example of the mode of applying this bandage the following official directions for its use in injuries of the head will be useful. Fold the lower border length-

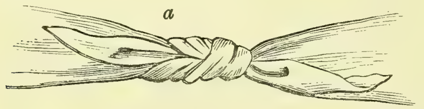


ways to form a plait, like a hem one and a half inches wide; place the middle of the bandage on the head, so that the plait lies crossways before the forehead, the point hanging downwards over the nape of the neck. Carry the two ends backwards above the ears, cross at the back of the head, bring forwards and tie on the forehead; then stretch the point downwards, and turn it up over the back of the head and fasten with a safety pin.

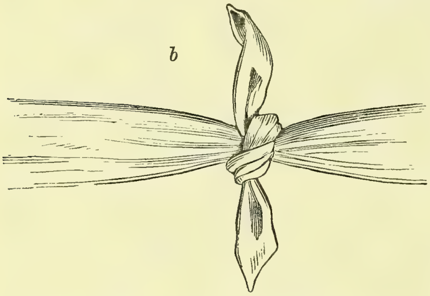


In tying the bandage, or indeed in tying anything which is required to hold securely, care must be taken to use a reef-knot (*a*), and not what is called a "Granny" (*b*).

a

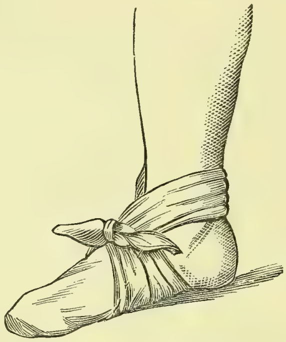


b



Wounds of the hand. Take a bandage, spread it out and lay the wrist on the lower border, with the fingers towards the point. Next turn the point over the fingers, and carry it up to the wrist. This done, take the ends round the wrist, fixing the point; cross them, carry them back again, and knot together. Take a second bandage and support the forearm in the larger sling.

Wounds of the foot. Take a bandage, spread it out and place the sole of the foot in its centre, with the toes in the direction of its point. Draw the point upwards over the toes and instep of the foot; then take the ends forward, round the ankle, cross on the instep, carry them downwards, and knot them together on the sole of the foot.



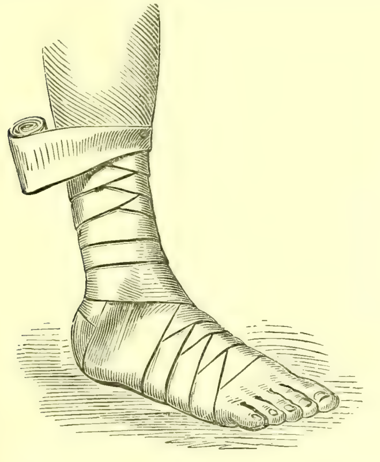
The placing of a roller bandage is not quite such an easy matter as it might appear, and requires a certain amount of practice, otherwise it will be found to slip off.

"In applying any bandage the operator should grasp the roll in one hand, and taking the loose end in the other, apply it to the limb, so that the outer surface may be against the skin, by which the roller as it is carried round will always lie close to the limb, and the bandaging will be much neater than if applied in the contrary way.

"The spiral bandage, as its name implies, consists in covering the limb by a series of spiral turns, each overlapping the one below for about one third of its width. In practice, however, owing to the enlargement of the limbs at the upper part, it is impossible to apply this bandage without making turns in it, *i. e.* folding the bandage upon itself so as better to accommodate the shape of the limb; to do this successfully is a little difficult. Attention to the following rules will be found to be of great assistance: 1. A turn should never be made over a prominence of bone, and wherever possible it should be on the outside of a limb. 2. However tightly the bandage may have been drawn before, at the moment of making the turn it should be held quite loosely, when with one movement of the wrist the required turn may be made and can afterwards be pulled as tight as may be necessary. 3. In making the turn the hand should be held slightly above the level of the limb, and care be taken not to unroll more bandage than is actually required for its performance. The spiral is most applicable to the surface of the limb, the figure of eight to the joints; this latter has no turns in it. In bandaging a limb a combination of the two would be used as in the annexed cut of a bandaged foot, in which the spiral has been used in the foot, the figure of eight round the ankle, and the spiral begun again at first plain and afterwards with turns in the leg" (*Heath*).

The form and nature of the part, and the object in view, should always receive consideration; as should also the condition of the patient after their application—whether of repose, exercise, or labour. The safest, simplest, and most effective means of fastening them is, in most

cases, furnished by a common needle and thread or cotton. It is more usual in surgical practice to split the free end of the bandage, tie a knot



with the two halves to prevent the split extending further than intended, and then secure the whole by tying the two ends round the limb.

Bandage, Mus′tard. A woollen roller soaked in a mixture of the best flour of mustard and warm water, of the consistence of fresh cream, the excess of moisture being expelled by gentle pressure.—Used to envelope the body, or a limb, by repeatedly folding it round the part; in the cold stages of cholera, and in other cases requiring an energetic stimulant. Other medicaments, particularly those of a stimulating and anodyne character, are sometimes applied in the same manner.

BANDAN′A. [Ind.] *Syn.* BANDAN′NA. A handkerchief, originally from the East Indies, having white spots on a red, blue, or other dark ground. In *calico-printing*, a 'discharge style' in imitation of the Indian bandanas. The fabric, many folds thick, is placed between leaden plates having the pattern cut out of them; hydraulic pressure is then applied, and a clear solution of chloride of lime forced through, followed by a stream of pure water. The colour is discharged by the chloride of lime in those parts vertically under the perforations, but is unable to spread beyond in consequence of the great pressure.

BAND′OLINE (-lĭn; -lēne‡). See FIXATURE.

BANE. Poison; anything deleterious or destructive; a word often found joined to another, in the popular and vulgar names of plants and disease, to denote their character; as BANE′-BERRY, the herb Christopher; BANE′WORT, deadly nightshade; WOLF'S-BANE (*Aconitum napellus*); SHEEP'S-BANE, the rot, &c.

BANG, Bangue (băng). [Nat.] See HEMP, INDIAN.

BAN′IAN (băn′-yăn). The *Fi′cus in′dicus* (*Ficus bengalensis,* L.), or Indian fig, one of the most famous trees of India, remarkable for its enormous extension by means of rooting branches. The milky juice is made into bird-lime, the leaves are made into platters. The fruit and young branches yield one species of gum-lac; and both the juice and bark are used medicinally.

Among sailors, BANIAN DAYS are those on which butcher's meat is not served up at dinner.

BANN′OCK (-ŭk). In Scotland and the northern counties of England, a flat round cake made of oat, rye, or barley meal, baked on an iron plate over the fire, or on the hot hearth.

BAOBAB (*Adansonia digitata,* L.), one of the BOMBACEÆ, or silk-cotton trees, is a native of West Africa. The gourd-like fruits contain an eatable acid pulp; they are used in Bombay as floats for fishing nets and bottles for holding water. Trunks have been measured 30 feet in diameter. The wood is light, soft, and of little use; the bark has been introduced for paper-making.

Adansonia Gregorii, F. Muell., is the AUSTRALIAN BAOBAB, or gouty stem tree. To the aborigines it is probably the most useful tree in tropical Australia; the pulp of the fruit is eaten both without preparation and after grinding and moistening. The kernels are slightly baked.

BAPTISIN. A resinoid or purified extract obtained from the root of wild indigo, *Baptisia tinctoria.* It is of a yellowish-brown colour. In small doses it is laxative; large doses emetic and cathartic.—*Dose,* 1 to 5 gr.

BARBADOES PRIDE (*Cæsalpinia pulcherrima,* Sw.). Used in the East Indies as a substitute for senna.

BAR′BERRY. *Syn.* PEP′PERIDGE BUSH‡, THORNY BOX′-TREE*; BER′BERIS, B. VULGA″RIS (*Linn.*), L.; EPINE-VINETTE, VINETTIER, Fr.; BERBERITZE, Ger. A perennial bush or shrub common in woods and hedges. Berries (BAR′-BERRIES, PEP′PERIDGES), gratefully acid, cooling, and astringent; used in pastry, but require, according to their degree of ripeness, from one half to an equal weight of sugar. Both bark and berries were formerly esteemed in jaundice, biliary flukes, &c. The crushed berries with water form a refreshing fever drink. The root dyes a fugitive yellow. The Indian barberry (*Berberis lycium,* Royle) is a native of the Western Himalayas. The root bark is bitter and tonic, as are also those of *B. Asiatica,* Roxb., and *B. aristata,* DC. Under the name of RUSOT, a watery extract from the stem and root bark of various species is used in ophthalmia and as a tonic and febrifuge in India. See BERBERINE, JAMS, PRESERVES, &c.

BARBS. *Syn.* LAMPAS, SKEW. This occurs in horses from two to four years old, and arises from a little inflammation of the ridges that pass along the palate, above and behind the incisor teeth, occasionally preventing the animal from eating and setting up slight fever. The best treatment is to scarify the enlarged ridges freely with a lancet or penknife, and to give for a time bran mashes, soaked grain, and other soft food.

BAREGE (barège, băr-răzhe′). [Fr.] A light woollen fabric so named from having been first made in the valley of Barèges. Of late years Paris has become celebrated for its barèges; but these are generally woven with the 'warp' of silk, and the 'woof' of wool. In the common imitations of the shops, the 'warp' is generally of cotton.

BAREGINE (barégine). See GLAIRINE.

BARIL'LA. [Eng., Ger., L., Sp.] *Syn.* SO'DÆ CAR'BONAS VENALE, L.; BARIG"LIA, BARIL'LOR, Sp., Lev.; BARILLE, SOUDE, Fr. The alkaline residue left on incinerating certain species of plants which grow on the seashore or in the neighbourhood of salt springs; hence probably the name, *barilla* or *varilla* being the Spanish for brushwood. The ashes of most plants contain carbonate of potassium; certain plants, however, which only grow in the above-mentioned situations yield, when incinerated, carbonate of sodium, the common salt which they absorb being converted —at least partially—into oxalate, tartrate, and other organic salts of sodium, and these, on incineration, are decomposed, forming carbonate of sodium. It is remarkable that plants growing in the sea itself yield very little sodium carbonate when incinerated, the residue (kelp or varec) consisting mainly of potassium sulphate, chloride, and iodide.

The manufacture of carbonate of sodium from these plants was formerly a considerable industry, the bulk of commercial soda being then derived from this source. Since the introduction, however, of soda made artificially by Leblanc's and other processes, the industry has diminished to very small proportions; thus in 1834, 12,000 tons of barilla were imported from Spain; in 1850, 1744 tons; in 1856, 2730 tons; and in 1864, 1262 tons.

The following are the chief soda-yielding plants:—*Atriplex portulacoides, Chenopodium, Salsola soda, kali, tragus, arenaria, clavifolia, vermiculata, brachiata; Salicornia arenaria, Europæa; Kochia sedoides;* also *Statice limonium* (PLUMBAGINEÆ), *Triglochin maritimum* (JUNCEÆ), and some FICOIDEÆ—*Reaumeria, Tetragonia, Nitraria,* and *Mesembryanthemum* (*crystallinum.*)

The yield of carbonate of sodium obtained from the above plants varies considerably; thus *Salsola clavifolia* yields 45·99%, *S. soda* 40·95%, *S. kali* 34·00%, *S. brachiata* 26·26%, *Kochia sedoides* 30·84%; whilst *Schoberia acuminata,* grown in the Russian steppes, contains only 7·2% Na_2CO_3. (The above is taken from 'The Manufacture of Sulphuric Acid and Alkali,' by G. Lunge, London, 1880.)

The extraction of crude soda from these plants is very simple. They are collected and dried in the sun, and are then incinerated in pits 1 to 1½ yards square, and paved at the bottom. The combustion of the dried plants is kept up for several days, fresh plants being added from time to time. By this means the quantity burning at one time is never very large, and there is always a free access of air and a not excessive temperature. The ashes as they collect are kept well in the centre of the pit. They gradually reach a red heat and then form a pasty mass, which is worked up with tools into a cake, to be afterwards broken up and crushed when cooled. A furnace in which the waste heat is utilised in drying the plants has also been used.

Barilla varies in composition and appearance, both according to the place where it has been manufactured and the manner in which it has been burnt. The best comes from Spain (chiefly from Valencia), and is known as Alicante, Cartagena and Malaga soda.

ALICANTE SODA is divided into three classes, according to the purity of the product and the care which has been taken in the incineration. *Soude douce* is a well-fused ash-like mass containing 20% to 25% Na_2CO_3. *Mélangée* forms a blackish honeycombed mass, with a sharp fracture. *Bourde* is a very low quality containing much coal, common salt, and earthy impurities.

MALAGA and CARTAGENA barillas are sent into the market in the form of heavy blocks of a grey colour, and marked with white, green, and black spots. They contain about 14% of soda.

In the south of France two qualities are obtained—the *salicor* or Narbonne soda (from *Salicornia annua*), containing 14% to 15% Na_2CO_3, and 'blanquette' or 'Soude d'Aigues-Mortes,' from different localities and species, and containing from 4% to 10% Na_2CO_3. 'Varec' from the north of France contains but little sodium carbonate, and Scotch or Irish kelp contains none at all. Some varieties of varec or kelp, however, contain much sodium carbonate and little iodine; in fact, soda was at one time made in England from this source. Soda from Teneriffe (from *Mesembryanthemum crystallinum*) consists of large irregular dark grey lumps containing about 20% Na_2CO_3. The following table gives the composition of the more important barillas:

Analysis of Vegetable Soda (*Girardin,* 'Journ. f. Pract. Chemie,' xxxvi, p. 123).

	From Alicante (Soude Bourde).	Cherbourg (varec).		Vilette (varec).	Unknown origin.		Granville (varec)
		a.	*b.*		*a.*	*b.*	
Na_2CO_3	2·00	9·53	3·71	13·76	6·00	6·00	0·22
K_2SO_4	...	22·19	42·54	20·35	18·80	22·00	13·50
KCl	...	16·00	19·64	10·53	...	...	15·60
NaCl	65·00	45·78	25·38	54·11	73·20	68·00	65·68
$CaSO_4$	...	...	...	...	...	...	...
Insoluble	3·00	1·50	0·73	...	...	...	...
Iodine	...	trace	trace	trace	trace	trace	trace
Na_2SO_3	30·00	...	...	...	...	...	...
H_2O	...	5·00	8·00	1·25	2·00	4·00	5·00
Loss	...	...	...	...	...	...	...

On lixiviating barilla with water, the insoluble salts (calcium, magnesium, and iron compounds) are left behind, whilst the solution contains—in addition to sodium carbonate—potassium carbonate, sulphates and chlorides of both alkalies, and small quantities of sulphides and hyposulphites (thiosulphates) produced by the reduction of sulphates by carbon during the incineration. Barilla is frequently adulterated with common salt.

For the *assay* of barilla see ALKALIMETRY.

Uses. Chiefly for soap and glass making. At the present day it is almost entirely superseded by artificial soda, at least in England.

BARIUM. Symbol Ba; atomic weight 136·8. A metallic element, analogous in properties, &c., to calcium and strontium. The articles upon

these two metals and their compounds should be read in conjunction with this one.

Sources. The chief naturally-occurring compounds are (1) the sulphate (BARYTES, or HEAVY SPAR, $BaSO_4$), and (2) the carbonate (WITHERITE, $BaCO_3$).

Prep. The metal was first obtained in 1808 by Sir H. Davy. It is best prepared by electrolysing a fused mixture of barium chloride with a little ammonium chloride; small globules of metallic barium are formed on the negative electrode, which should consist of a fine harpsichord wire. Barium amalgam may be obtained by electrolysing a solution of barium chloride, using mercury as the negative electrode; by treating a strong solution of barium chloride with sodium amalgam; or by passing sodium or potassium vapour over heated baryta, and extracting the product with mercury. The amalgam may be freed from much (but not all) of its mercury by distillation.

Prop. Barium has never been obtained pure in masses larger than small globules, and its physical properties are therefore but little known. Its colour is variously described as yellowish or greyish-white; it is malleable, fuses at a higher temperature than cast iron, oxidises easily in air, and decomposes water spontaneously (baryta being formed, and hydrogen liberated). Sp. gr. = 3·5 to 4. Its two oxides are the monoxide (BaO) and the peroxide (BaO_2) (*which see*).

Tests for. Barium compounds colour a non-luminous flame yellowish-green; the spectrum is complicated, containing several lines in the green. In solution barium salts give with ammonium carbonate a white precipitate of carbonate, soluble in acids; with ammonium oxalate, in neutral solutions, a white precipitate of oxalate, soluble in acids; and with dilute sulphuric acid a white precipitate of sulphate, insoluble in acids. They may be distinguished from salts of calcium and strontium by their solutions giving a white precipitate with a solution of calcium or strontium sulphate (solutions of strontium salts are likewise thrown down by calcium sulphate), a white precipitate with hydrofluosilicic acid, and a light yellow precipitate with bichromate of potassium. (Concentrated solutions of strontium salts are also precipitated by potassium bichromate). The colour which barium salts impart to the non-luminous flame is thoroughly characteristic.

Estimation. Barium is usually estimated by precipitating the solution containing it with sulphuric acid, and weighing the sulphate formed (see SULPHURIC ACID, ESTIMATION OF); it is also sometimes determined as the carbonate, and, in presence of calcium and strontium, as the silicofluoride.

Salts. All these, except the sulphate, are readily soluble in water or dilute hydrochloric acid, but only slightly soluble in strong hydrochloric and nitric acids. The sulphate is one of the most insoluble bodies known, but it can be converted into a soluble salt (see BARIUM, SULPHATE OF). The salts of barium may all be prepared by saturating solutions of the corresponding acids with baryta water, or with barium carbonate or sulphide. With the exception of the sulphate, they are all extremely poisonous; and they are all colourless, excepting those with coloured acids, *e. g.* the chromate and manganate. The carbonate and salts of organic acids give the oxide (baryta) when ignited. The hydroxide is more, and the sulphate less, soluble than the corresponding strontium and calcium compounds.

Pois., &c. The sulphate, owing to its insolubility, is the only salt of barium which is not poisonous.—*Symp.* Nausea, vomiting, pains in the head, ringing in the ears, vertigo, and intermitting cramps and convulsions; the respiration is frequently suspended for several moments, and the pupil is generally dilated. The symptoms, however, often vary, and are not very distinctive. —*Treatm., Ant., &c.* Vomiting, followed by copious draughts of water soured with sulphuric acid, or sulphate of soda (Glauber salt) or sulphate of magnesia (Epsom salt), dissolved in a large quantity of water. When carbonate of barium has been swallowed, a mixture of one of the above sulphates and weak vinegar should be taken after the vomiting, in order that a soluble barium salt may be first formed, on which the alkaline sulphate will act more readily. Subsequent irritation may be soothed by opium or morphia.

Barium, Ac'etate of. $Ba(C_2H_3O_2)_2 + H_2O$. *Syn.* BARY'TÆ ACE'TAS, L. *Prep.* Dilute acetic acid is neutralised with barium carbonate, and the resulting solution is evaporated to a small bulk and allowed to crystallise.

Uses, Dose, &c. Same as the chloride. It is seldom employed.

Barium, Arse''niate of. $Ba_3(AsO_4)_2$. *Syn.* BARY'TÆ ARSE''NIAS, L. *Prep.* Barium chloride is added to a solution of sodium or potassium arseniate, and the precipitate is collected, washed, and dried. By dissolving this salt in a solution of arsenic acid, and crystallising the resulting solution, BINARSE''NIATE OF BARIUM is obtained. Has been recommended in certain skin diseases, and in phthisis complicated with scrofula.—*Dose,* $\frac{1}{16}$ to $\frac{1}{4}$ gr.

Barium, Ar'senite of. $Ba_3(AsO_3)_2$. *Syn.* BARY'TÆ AR'SENIS, L. Very slightly soluble.—*Use, &c.* As the last.

Barium, Bromide of. $BaBr_2$. *Syn.* BA''RII BROMI'DUM, L.; BROMURE DE BARYUM, &c., Fr.; BROMBARIUM, Ger. *Prep.* Boil a solution of ferrous bromide with a slight excess of moist barium carbonate, filter, evaporate the filtrate to dryness, and ignite the residue. Barium bromide may be obtained in crystals by carefully evaporating its aqueous solution. It is soluble both in alcohol and in water, and its physiological properties resemble those of barium iodide.

Barium, Carbonate of. $BaCO_3$. *Syn.* CARBONATE OF BARY'TA; BARY'TÆ CARBONAS, L.; CARBONATE DE BARY'TE, &c., Fr.; KOHLENSAURES BARYT, &c., Ger. A heavy white mass or powder, almost insoluble in water, and decomposed by nearly all acids. It occurs naturally as the mineral *witherite*, which is found largely at Fallowfield, near Hexham, in Northumberland. Native barium carbonate is used, according to the Pharmacopœias, for making the other barium salts; for this purpose it is sufficiently pure. If absolutely pure barium carbonate is required, it may be obtained by adding an alkaline carbonate

to a solution of barium chloride, or by saturating barium hydrate with carbonic acid, and in either case washing and drying the precipitate.

Uses. In *pharmacy*, &c., chiefly to prepare barium salts. In *chemistry*, to separate certain metallic oxides when these occur together in solution. In the *arts*, as a base for certain delicate colours, as an ingredient of plate glass, in the manufacture of beet-sugar, &c. It is not used in medicine. It is extremely poisonous, and is used as a rat-bane.

Barium, Chlorate of. $Ba(ClO_3)_2$. *Syn.* CHLORATE OF BARY'TA; BARY'TÆ CHLO''RAS, L. *Prep.* 1. A solution of chloric acid is neutralised with freshly-precipitated barium carbonate; the resulting solution is filtered, and the filtrate is evaporated to small bulk and allowed to crystallise. 2. Chlorine is passed through water containing barium hydrate or carbonate in suspension.

Prop., &c. Soluble in 4 parts of cold and in 4-5th parts of hot water. Used in *pyrotechny* to give a green colour to the flame, and also for making chloric acid.

Barium, Chloride of. $BaCl_2 + 2H_2O$. *Syn.* CHLORIDE OF BARIUM; BARII CHLORIDUM, L.; CHLORURE DE BARIUM, CHLORHYDRATE DE BARYTE, Fr.; CHLORBARIUM, SALZSAURESCHWERERDE, Ger. *Prep.* 1. Hydrochloric acid is treated with witherite (a slight excess of carbonate should be added, most other metals present being thus precipitated as oxides or basic salts on standing); the clear solution is then exactly neutralised with hydrochloric acid, evaporated to small bulk, and allowed to crystallise. 2. Barium sulphate (100 parts) is heated with charcoal (35 to 50 parts), limestone (15 to 20 parts), and calcium chloride (40 to 60 parts) to redness in a reverberatory furnace, and the resulting product is lixiviated, to dissolve out the barium chloride formed. 3. From the manganese chloride formed in the manufacture of chlorine. This is neutralised with chalk, the clear solution then evaporated, and the residue heated to redness on a cast-iron plate with barium sulphate and silica; barium chloride is obtained from the resulting product by lixiviation. 4. It has also been formed by heating the sulphate with carbon in a current of gaseous hydrochloric acid. If required absolutely pure, ordinary barium chloride must be dissolved in water, and the solution saturated with hydrochloric acid gas; pure barium chloride is then precipitated as a white crystalline powder. This must be washed repeatedly with hydrochloric acid, and finally with alcohol, to remove the acid; it should then be dried at once, and carefully preserved from the air.

Prop. Barium chloride crystallises in flat rhombic tables of the composition $BaCl_2 + 2H_2O$, which lose their water of crystallisation at 113° C. (235° F.), and melt at a red heat (partial decomposition takes place here, some baryta being formed and hydrochloric acid evolved). It is insoluble in alcohol and in hydrochloric acid; 100 parts of water dissolve at 20° C. (68° F.), 36 parts, at 100° C. (212° F.), 59 parts of the anhydrous salt (= 42 and 79 parts of the crystallised salt).

Uses, Phys. Eff., &c. In *chemistry*, it is employed as a test reagent for sulphuric acid and the soluble sulphates; it is also used in the preparation of 'PERMANENT WHITE,' and as an anti-incrustator to remove the calcium sulphate from water intended for use in steam boilers. In *medicine* it has been employed, both internally and externally, as an alterative, resolvent, and deobstruent, in scrofula, glandular swellings, and enlargements, scirrhous cancer, skin diseases, &c.; and more particularly in the first with marked benefit. In large doses it is poisonous. According to Sir B. Brodie, its action on animals is analogous to that of arsenic. Locally, it acts as an irritant. A very weak solution, used as a lotion, often proves serviceable in herpetic eruptions, and as a collyrium in scrofulous ophthalmia.—*Dose*, ½ gr. thrice a day, in water, gradually increased to 2 or 3 gr.

Barium, Ferrocy'anide of. $Ba_2Fe(CN)_6$. *Syn.* BA''RII FERROCYANI'DUM, L. *Prep.* By digesting ferrocyanide of iron with baryta water, and carefully evaporating the resulting solution, efflorescent prismatic crystals of this salt are obtained, which are soluble in 4½ parts of water.

Barium, Fluoride of. BaF_2. *Syn.* BA''RII FLUORI'DUM, &c., L. *Prep.* 1. By digesting freshly-precipitated barium carbonate with excess of hydrofluoric acid. 2. By digesting calcium fluoride with barium chloride, or by igniting the two substances together and extracting the product with water; in either case calcium chloride dissolves, and barium fluoride is left as an insoluble white powder.

Barium, Hydroxide of. $Ba(OH)_2$. *Syn.* HYDRATE OF BARYTA; BARY'TÆ HYDRAS, L. *Prep.* 1. By digesting caustic baryta with a little water, or by gently igniting the crystallised hydrate (this latter may be obtained by precipitating a concentrated solution of barium nitrate or chloride with strong caustic soda or potash free from carbonic acid). 2. By boiling a solution of barium sulphide with excess of black oxide of copper, filtering, and evaporating the clear liquid. 3. By treating the carbonate with superheated steam.

Prop. A bulky white amorphous powder, melting at a low red heat to an oily liquid, which solidifies to a crystalline mass. It is soluble in 20 parts of cold, or 2 of boiling water; the solution, when concentrated, deposits the crystallised hydrate, $Ba(OH)_2 + 8H_2O$, which contains 51½% of water. On drying and igniting, 8-9ths of this water is lost, the common hydrate, $Ba(OH)_2$, being formed; this latter only loses the rest of its water at a very high temperature, forming caustic baryta, BaO. An aqueous solution of barium hydroxide forms a very sensitive reagent for the detection and estimation of carbonic and sulphuric acids (which *see*).

Barium, Iodide of. BaI_2. *Syn.* BA''RII IODI'DUM, L.; IODURE DE BARYUM, &c., Fr.; JODBARIUM, &c., Ger. *Prep.* 1. Saturate hydriodic acid with oxide or carbonate of barium. 2. Dissolve barium sulphide in water, add gradually excess of iodine, filter, and evaporate the filtrate to dryness or allow it to crystallise. 3. Digest excess of freshly-precipitated barium carbonate with a hot solution of ferrous iodide, filter, and evaporate the filtrate to dryness; redissolve the residue in water, and recrystallise it.

It has been highly recommended as an alterative, resolvent, and liquefacient, particularly in scrofula, glandular swellings, chronic inflammations, and the other affections in which chloride of barium and iodine are given.—*Dose,* $\frac{1}{12}$th to $\frac{1}{8}$th gr., gradually and cautiously increased to 1 gr., in distilled water, two or three times a day. Externally, as an ointment (3 or 4 gr. to 1 oz. of lard), as an application to scrofulous swellings (*Biett*). It possesses all the irritant, corrosive, and poisonous properties of the chloride, but in a much more violent degree.

Barium, Manganate of. $BaMnO_4$. One of the few harmless green pigments. Made by igniting pyrolusite with three times its weight of barium peroxide.

Barium, Nitrate of. $Ba(NO_3)_2$. *Syn.* NITRATE OF BARYTA; BARY'TÆ NI'TRAS, L. *Prep.* Like the acetate or chloride of barium, substituting pure nitric acid for acetic or hydrochloric acid.

Prop., &c. Crystallises in transparent colourless octahedra, which are insoluble in alcohol, but dissolve in $12\frac{1}{2}$ parts of cold, and in 3 parts of boiling water.

Uses. In *chemistry,* to prepare the oxide (baryta), and as a test reagent for sulphuric acid and the soluble sulphates; in *pyrotechny,* to give a green-coloured flame. An explosive substance, *Saxifragin,* consists of barium nitrate 76, charcoal 22, and nitre 2 parts.

Barium, Oxalate of. BaC_2O_4. *Syn.* OX'ALATE OF BARYTA; BARY'TÆ OX'ALAS, L. *Prep.* By precipitating a neutral or alkaline solution of a soluble barium salt with ammonium oxalate. It is a white powder, almost insoluble in water, but easily soluble in acids (except sulphuric, which converts it into the sulphate).

Barium, Oxide of. BaO. *Syn.* BARYTA, CAUSTIC BARYTA, OX'IDE OF BA''RIUM, PROTOXIDE OF B., HEAVY EARTH; BARYTE, OXIDE DE BARYUM, TERRE PESANTE, &c., Fr.; BARYT, BARYTERDE, SCHWERERDE, &c., Ger. *Prep.* 1. By igniting a powdered mixture of barium carbonate and charcoal, which must afterwards be cooled out of contact with air. 2. By heating crystallised barium nitrate to redness in a Hessian crucible till no more red nitrous fumes are evolved, and cooling in a partial vacuum; pure baryta is thus obtained. 3. (*M. Rosenthiel's* process.) By boiling a solution of barium sulphide with zinc oxide, caustic baryta and zinc sulphate are formed. 4. By heating barium sulphate with iron oxide to 1000° C. or 1200° C., and afterwards heating the double oxide of iron and barium thus formed in a current of hydrogen; the iron oxide is reduced to the metal, and the barium oxide may be then dissolved out with boiling water.

Prop. A greyish-white, spongy, earthy mass, fusible only before the oxyhydrogen blowpipe; very caustic, corrosive, and alkaline. It rapidly absorbs moisture from the air and slakes on the addition of water, like quicklime, but with the evolution of more heat than in the case of the latter substance.

Barium, Peroxide of. BaO_2. *Syn.* DEUTOX'IDE OF BARIUM; BA''RII BINOXY'DUM, &c., L.; BINOXIDE DE BARYUM, &c., Fr.; BARIUM SUPEROXYD, Ger. *Prep.* 1. By heating pure baryta to redness in a stream of oxygen, or air. 2. By heating 4 parts of baryta to redness in a platinum crucible and adding gradually 1 part of potassium chlorate; the potassium chloride formed is afterwards washed away from the peroxide with cold water.

Prop. A grey or greyish-white powder, which forms a hydrate ($BaO_2 + 6H_2O$) with water; it is almost insoluble in cold water, and is decomposed by warm water.

Uses. In making hydrogen peroxide, and recently in the manufacture of oxygen by Brin's process. This process, which has apparently a brilliant future before it, will be found described under OXYGEN.

Barium, Phosphate of. $Ba_3(PO_4)_2$. This is the normal ortho-phosphate. *Prep.* By precipitating a neutral or alkaline solution of a barium salt with a solution of an alkaline phosphate. It is a white powder, almost insoluble in water, but soluble in acids (except sulphuric)—even in acetic acid.

Barium, Sulphate of. $BaSO_4$. *Syn.* SULPHATE OF BARYTA, HEAV'Y SPAR, BOLOGNIAN SPAR; CAWK, BARYTES (mi.); BARY'TÆ SUL'PHAS (Ph. E. & D.), SPA'THIUM PONDERO'SUM, &c., L.; SULPHATE DE BARYTE, SPATH PESANT, &c., Fr.; SCHWEFELSAURES BARYT, SCHWERSPATH, &c., Ger.

Sources. This salt occurs naturally, as a vein mineral in the lead mines of Northumberland, Westmoreland, Cornwall, and Derby, also at Bologna, and in several districts of Germany. It has sometimes the form of tabular crystals, but is more often found in white or reddish-white masses.

Prep. It is prepared artificially as a white powder by adding dilute sulphuric acid or sodium sulphate to a solution of barium chloride, and collecting, washing, and drying the resulting precipitate.

Prop. When pure and free from iron, its powder is white. Before the blowpipe it decrepitates, fuses with great difficulty (by which it is distinguished from calcium and strontium sulphates), and ultimately melts into a hard white enamel. It is insoluble in all ordinary solvents. By heating to redness with charcoal in a covered crucible it is reduced to the sulphide, which is soluble in water; and by fusion with alkaline carbonates, or by prolonged digestion with an aqueous solution of the latter, it is decomposed, soluble alkaline sulphates being formed, together with a white residue of barium carbonate, which is soluble in hydrochloric acid. Sp. gr. = 4·4 to 4·7.

Uses. Chiefly as a pigment (PERMANENT WHITE OR BLANC FIXE), and to adulterate white lead. For this purpose the native sulphate is usually ground to powder and well washed with dilute sulphuric acid and then with water, to remove any iron, which would impair the whiteness of the product. It is better, however, to use the artificial sulphate, which possesses much greater covering power as a pigment than the powdered spar, since it is in a much finer state of division. Barium sulphate is also used to prepare the sulphide, and in *pyrotechny* instead of the more expensive nitrate.

Barium, Sulphide of. BaS. *Syn.* SUL'PHIDE OF BARIUM, SUL'PHURET OF BARYTA; BA''RII

SULPHURE'TUM, &c., L.; SULPHURE DE BARYUM, &c., Fr.; SCHWEFELBARIUM, &c., Ger. *Prep.* By heating 100 parts of barium sulphate with 20 parts of slack coal, and extracting the product with water. Some sawdust is often added to aid the escape of the carbonic acid, and frequently instead of slack the asphalte from tar works is used, the hydrogen in this preventing the formation of higher sulphides.

Prop., Uses, &c. Dissolves in water with decomposition, barium hydroxide and hydrosulphide being formed. Its solution oxidises when exposed to the air, and when boiled with sulphur, higher sulphides are formed.

Bolognian phosphorus (a mixture of barium sulphide and sulphate) is obtained by heating 5 parts of precipitated barium sulphate with 1 of powdered charcoal for 30 minutes over a gas flame, and then for 10 minutes over the blowpipe. While the mixture is still hot, glass tubes are filled with it and sealed up; these, after exposure to light, phosphoresce with a bright orange colour,—hence its name.

Barium, Sulphite of. $BaSO_3$. *Syn.* SUL'PHITE OF BARYTA. *Prep.* By adding sodium sulphite to a soluble barium salt, and washing the precipitate formed. It is a white powder insoluble in water, and decomposed by acids.

Barium, Tartrate of. $BaC_4H_4O_6$. *Syn.* TARTRATE OF BARYTA. A white powder slightly soluble in water. *Prep.* Like the oxalate.

BARK. [Eng., Dan.] *Syn.* COR'TEX, L.; ÉCORCE, Fr.; BAUMRINDE, RINDE, Ger. The rind or exterior covering of vegetables, corresponding to the skin of animals. It consists of the cu'ticle or epiderm'is—cellular substance, containing colouring matter, &c., and li'ber, the inner or true bark. The last is formed of woody fibre in great quantity, intermixed with cellular tissue. At the commencement of the annual growth of a tree, the bark separates spontaneously from the wood, in order to make room for the new matter forming beneath. It thus increases by yearly layers, and gradually perishes on the outside, owing to distension, from the growth of the interior portion. Its physiological uses are numerous and important. It is the depository of many of the secretions of plants, and it acts as a living filter, separating secretions from each other, and allowing a part of them to pass off horizontally through the medullary processes on their way to the centre of the tree. But its principal offices appear to be to act as a protection to the tender wood, and as a channel for the sap in its descent from the leaves. "True bark only exists in exogens and gymnosperms; in endogens its place is supplied by cortical integuments, which cannot be separated from the adjacent wood, without violence" (*Lindley*).

According to Liebig, the characteristic ingredients found in bark are excrementitious—"substances evidently expelled by the living organism." True wood yields only ·25% to 2% of ash; whilst the bark of some trees give 6, 10, to 15 times more; and these, like the organic constituents, differ materially in their composition and characters.

The uses of different species of bark in medicine and the arts are well known. CINCHONA BARK is invaluable in fevers; OAK-BARK furnishes the tanner with one of the most important materials of his trade; and the tenacious fibres of other varieties are manufactured into cordage and textile fabrics.

Barks should be collected at that season in which they can be most easily separated from the wood, which, with a few exceptions, is late in the spring; because at this time the active principles deposited in their cells are most abundant. OAK-BARK, collected in spring contains four times as much astringent matter as that collected in winter.

Bark (in *medicine*). See CINCHONA.

Bark (in *tanning*). See OAK.

Bark, Jes'uit's. Cinchona bark.

Bark, Salt of (Essential). See EXTRACTS and SALTS.

BAR'LEY. *Syn.* HOR'DEUM, L.; ORGE, Fr.; GERSTE, Ger., Anglo-S. A well-known grain, the produce of several species of the genus *Hordeum.*

Var., Cult., &c. Those principally cultivated in England are—TWO'-ROWED, LONG'-EARED, or COMM'ON BARLEY (*Hor'deum distichum,* Linn.); SPRING BARLEY, SQUARE B., or BERE (*H. vulga''re,* Linn.); and SIX-ROWED BARLEY, WINTER B., Scotch BERE or BIGG (*H. hexas'tichum,* Linn.) BUT'NEY, SPRAT, or BATT'LEDORE B. (*H. zeocriton,* Linn.), is another species less frequently met with. Of each of the above there are several varieties. In Spain and Sicily, two crops of barley are obtained in a year; but in countries so far north as Britain, it produces only one, and is a delicate species of grain. In England it is generally adopted as a succession crop on light lands, following turnips or green crops (*Loudon*). The 'yield' per acre varies from 28 to 64 bushels, and is usually from 28 to 40 bushels. The average weight per bushel is 50 to 51 *lbs.*; but the best Norfolk and Essex samples weigh 53 to 54 *lbs.*; per bushel.

Comp. The leading constituents of barley are nearly similar to those of wheat, but it is scarcely so rich in nitrogenised matter. According to Einhof, the ripe SEEDS or GRAINS are composed of—

Meal	70·05
Husk	18·75
Moisture	11·20
	100·

According to Johnston, average fine BARLEY-MEAL contains—

Starch	68·
Albumen, gluten, &c.	14·
Fatty matter	2·
Ash or saline matter	2·
Water	14·
	100·

According to Payen, dried barley possesses the following composition:

Nitrogenous matter	12·96
Starch	66·43
Dextrin	10·00
Fatty matter	2·76
Cellulose	4·75
Mineral matter	3·10
	100·00

According to Dr Ure, the sp. gr. of ENGLISH BARLEY is 1·25 to 1·33 (average 1·235), and the weight of the husk is about 1-6th; that of BIGG, 1·227 to 1·265, and weight of husk, 2-9ths.

The analyses of the following varieties of barley, gave as the composition of the ashes of the grains:

	Unknown.	Chevalier Barley.	From Moldavia.	Chevalier Barley.
Potash	21·14	20·77	37·55	7·70
Soda	...	4·56	1·06	0·36
Lime	1·65	1·48	1·21	10·36
Magnesia	7·26	7·45	10·17	1·26
Sesquioxide of iron	2·13	0·51	1·02	1·46
Sulphuric acid	1·91	0·79	0·27	2·99
Silica	30·68	32·73	24·56	70·70
Phosphoric acid	28·53	31·69	38·64	1·99
Chloride of sodium	1·10	...	1·47	1·10

In the 'Journal of the Agricultural Society' for 1873 is a report by Messrs Lawes and Gilbert of twenty years' experiments with barley. The soil of a field at Rothampstead, in which the barley had been grown for twenty years, consisted of heavy loam, with a subsoil of clay resting on chalk, and was previous to the barley being planted almost exhausted by cropping. The produce was found to be greatest during the absence of drought and sudden alterations of temperature, the rather cool but uniform season of 1854 giving the heaviest crops. The yield from farmyard manure and nitrate of soda was found in dry seasons to be rather larger than that from ammonia salts. Barley manured with phosphates was found to ripen one to two weeks earlier than when the phosphate was omitted.

The average produce per acre of a few of the principal plots is given below. The 'ammonium salts' are stated to be a mixture of equal parts of sulphate and chloride; the 'alkali salts' consist of the sulphates of potassium, sodium, and magnesium; the 'cinerials' consist of alkali salts, plus superphosphate:

Manures per Acre.	Dressed Corn.	Straw and Chaff.	Total Produce.	Corn to 100 Straw.	Weight per Bushel of Dressed Corn.	Produce of second 10 yrs. over or under first 10 yrs.
	Bushels	cwts.	lbs.		lbs.	per cwt.
Unmanured	20	11¾	2454	86·6	52·3	−23·6
Mixed cinerials	27½	14⅜	3162	96·4	53·4	−20·2
Ammonium salts, 200 lbs.	32½	18½	3919	89·2	52·1	− 9·7
Ammonium salts, 200 lbs., and alkali salts	35	20¾	4317	86·3	52·8	− 5·3
Ammonium salts, 200 lbs., and superphosphate	47	27⅝	5760	86·8	53·5	+ 2·7
Ammonium salts, 200 lbs., and cinerials	46¼	28½	5817	83·2	54·0	− ·3
Rape cake (mean 1300 lbs.)	45¼	26⅞	5571	87·3	53·8	
Farmyard manure, 14 tons	48¼	28¼	5933	88·5	54·3	+14·8

The authors direct attention to the results obtained by using the cinerial manure alone, as illustrating the unsoundness of the old 'mineral theory,' according to which plants were supposed to possess a sufficient source of nitrogen in the atmosphere. They found a greater crop yielded by barley than wheat when no manures were employed, a fact which they attribute to barley being better able than wheat to supply itself with nitrogen, notwithstanding the deeper roots of the latter. They state that with both wheat and barley the produce is slowly falling off under these circumstances. With ammonium salts alone, and with nitrate of sodium alone, there is much less falling off than when no nitrogenous matter is used. The falling off was least with the nitrate. The nitrate gives a rather larger crop for the same amount of nitrogen supplied, and they found this to hold when both nitrate and ammonia are applied with cinerials. The addition of superphosphate to ammonium salts or sodium nitrate greatly increases the produce; the further addition of potassium, sodium, and magnesium salts they found almost without effect.

The inference was that the barley had obtained an ample supply of potash from the natural soil, but an insufficient supply of phosphoric acid.

When ammonium salts are used alone, and the quantity of ammonia does not exceed 50 lbs. per acre, 3·68 lbs. of ammonia will yield an average increase of 1 bushel of corn and 63 *lbs.* of straw—total, 115 *lbs.*; the extremes in 20 years were 2·25—18·05 *lbs.* When ammonium salts are applied with superphosphate, 2·21 *lbs.* of ammonia will produce the same result; the extremes were 1·47—5·36 *lbs.*

Silicate of sodium had been applied for eight years and a half to half the barley plots receiving ammonia; no increase has resulted where ammonia and superphosphate are employed; but on the other three plots an increase had taken place, which, in the case of the plot receiving only ammonia and alkali salts, is very considerable.

The authors think this irregular reaction seems to show that the silicate has not produced its effect by furnishing silica to the crop, but by some reaction upon the plant-food of the soil. The rape cake supplied much more nitrogen than the ammonium salts, and also some phosphates and potash. Rape cake alone gives a better return than either ammonium salts or sodium nitrate applied alone; but when the three manures are mixed with superphosphate, the results for equal amounts of nitrogen show the rape cake to be decidedly inferior. From the above experi-

ments it is inferred that a supply of carbonaceous matter does not increase the crop of barley.

A farmyard manure containing about 0·64% of nitrogen supplied far more plant food than any of the other manures. On an average of twenty years it was found that about 8 lbs. of ammonia in the form of dung would produce a bushel of barley, with its equivalent of straw.

In all cases which were comparable it was found that barley appropriates more of the nitrogenous manure than wheat, save with farmyard manure. A large amount of nitrogen applied by manure is not taken up by the crop. Experiments in the barley field proved that large residues from ammonium salts and sodium nitrate show a small but distinct effect upon succeeding crops, the influence extending over many years. From an examination of the drainage waters from lands dressed with the nitrates of ammonium and sodium, the authors conclude that ammonium salts, as well as sodium nitrate, will be more economically applied in the spring than in the winter. Manures containing organic nitrogen are clearly not so liable to loss from drainage.

Experiments were made on the growth of barley after turnips, and also in an ordinary four-course rotation. After growing turnips ten years consecutively with purely cinerial manures, and carting off the produce, the yield of barley was much smaller than in the experimental field, where barley was grown after barley. The turnips, though very small crops, had exhausted the soil of nitrogen to a greater extent than corn crops would have done. On one plot where rape cake had been applied to the turnips, the produce of barley was 8¼ bushels more than when none had been used. In the rotation experiments barley was grown after turnips (carted off), and was followed by beans and wheat. In one series all the crops were unmanured; in another the turnips received superphosphate; in a third the turnips received an abundant cinerial and nitrogenous manure.

The mean produce of the six crops of barley obtained in twenty-four years of rotation was as follows:

Character of Rotation.	Dressed Corn	Straw and Chaff.
	bushels.	cwt.
Unmanured continuously . .	38⅜	21¾
Superphosphate for turnips only	29¾	16½
Mixed manure for turnips only	44⅜	25¼
Mean produce of unmanured barley in barley-field during the same season	21½	12⅛

The unmanured turnips were so very small in quantity, that the barley in the first series was practically grown after a fallow; this barley, however, was a much larger crop than that grown after turnips manured with superphosphate only, the available nitrogen of the soil in this case being exhausted by the turnips.

In the last series the residue of the abundant manure applied to the turnip crop suffices to produce a good crop of barley.

Qual., Uses, &c. Its employment and value as food, and in the manufacture of malt, are well known. It forms good wholesome bread well adapted for persons who live luxuriously; but which, for the abstemious and the delicate, is inferior to that made of wheat, as it is rather less nutritious, and less easy of digestion, and commonly proves laxative to those unaccustomed to its use. Barley-flour and barley-meal are also more perishable than wheat-flour, being very apt to acquire a hot nauseous taste, which even the heat of the oven does not remove. From a medical point of view, barley is regarded as the mildest and least irritating of the cereals. It has always been in high estimation as a demulcent and emollient. The decoction (BAR'LEY-WATER), made with pearl barley, is a common and useful drink in inflammatory diseases, particularly in those of the chest and urinary organs. Among the Ancients, decoctions of barley (κριθή) were the principal aliments and medicines employed in acute diseases.

Barley was extensively cultivated by the Romans and many other nations of antiquity, as well as by the ancient inhabitants of Gaul. The Greeks are said to have trained their athletes on it.

The best tests of the genuineness of barley are its colour, freedom from dust, grit, and insects. The microscope will lead to the detection of any cheaper grains if mixed with it. It is rarely adulterated, although it is said to be extensively used for the purpose of sophisticating wheat, annatto, and roll liquorice.

Barley Starch.

Barley, Caus'tic. Sabadilla.

Barley, Pa'tent. *Syn.* FARI'NA HOR'DEI, L. Pearl barley reduced to fine powder by grinding in a mill.

Barley, Pearl. *Syn.* PEARL'ED BARLEY*; HOR'-DEUM DECORTICATUM (B. P.), L.; ORGE PERLÉ, Fr.; PERLENGRAUPEN, Ger. The seeds of *Hordeum distichum* deprived of the husks. That of commerce is usually made by steaming spring barley, to soften the skin, then drying it, and grinding it in a mill with the stones set wide apart, so as to round and polish the grains, and to separate the whole of the husk except that left in the furrow of the seed. SCOTCH PEARL BARLEY and FRENCH BARLEY resemble the last, but are smaller, being generally made from winter-

barley or bigg. Faro de Orzo is another variety made from sprat barley. See Barley (*above*).

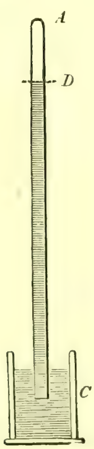
Barley, Scotch. *Syn.* Hulled barley‡, Pot-b.‡; Hor'deum munda'tum, L.; Orge mondé, Fr.; Gerstengraupen, Graupen, Ger. The grains deprived of the husk by a mill, as noticed above, but less completely, and without rounding them.

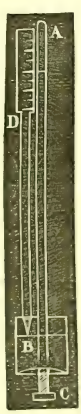
BAR'LEY SUGAR. See Confectionery and Sugar.

BARM. See Yeast.

BAROM'ETER (*baros*, weight; *metron*, measure). *Syn.* Weather-glass‡; Barom'etrum, L.; Baromètre, Fr.; Barometer, Wetterglas, Ger. An instrument for measuring the pressure of the atmosphere; invented by Torricelli, of Florence, A.D. 1643.

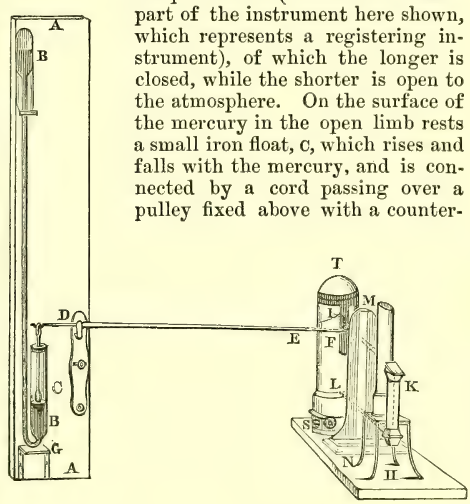
The barometer in all its forms, excepting the aneroid, is constructed by filling with mercury a clean glass tube closed at one end, at the same time boiling the mercury to exclude air, then (unless a siphon barometer is being constructed) closing the open end of the tube with the finger, inverting the tube, and withdrawing the finger when the end so closed is under mercury in an open vessel. The mercury, if the tube is sufficiently long, descends in the tube to an average height of about 30 inches, leaving the upper part of the tube filled only with mercury vapour, which exerts a slight pressure depending only on the temperature. The mercury is thus supported by the otherwise unbalanced atmospheric pressure on its lower free surface, and the varying height of the column supported gives a measure of the atmospheric pressure. The annexed figures show one or two of the principal varieties of the instrument.





The construction of a barometer requires considerable skill and care, but the making of a good and accurate instrument is by no means difficult, and is frequently performed by experimenters. An ordinary barometer, however carefully made, is found to suffer gradual deterioration from the external air insinuating itself between the mercury and the glass tube, by which the perfection of the vacuum is destroyed. Various plans have been proposed to remedy this inconvenience and source of error. The best plan is to provide the instrument with an air-trap in the tube between the scale and the cistern. Before purchasing an instrument it is as well to ascertain that this has been done. In those called 'standard barometers' the scale is moveable and adjustable by a delicate screw, so as to enable the observer to bring the lower point or zero of the scale coincident with the surface of the mercury in the cistern. Exact contact is readily effected by making an ivory point, B, which serves as zero mark, and is supported above the lower surface of the mercury, to coincide with its image as seen by reflection from the surface of the mercury. In this case the cistern is made of glass.

In what is called the wheel barometer or weather-glass, the tube is in shape a U with two unequal limbs (as in the left-hand part of the instrument here shown, which represents a registering instrument), of which the longer is closed, while the shorter is open to the atmosphere. On the surface of the mercury in the open limb rests a small iron float, C, which rises and falls with the mercury, and is connected by a cord passing over a pulley fixed above with a counter-

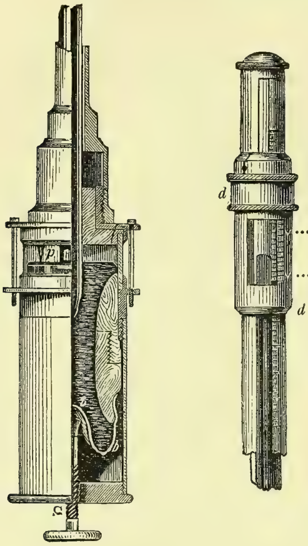


poise. Thus the pulley turns in one direction or the other as the mercury surface rises or falls, and an index attached to it turns round a graduated dial and gives an indication of the pressure.

Of the many forms of mercurial barometer, that known as Fortin's is perhaps the best. In this instrument the cistern and the lower portion of the tubes is shown in the annexed figure.

"The cistern is made of boxwood, with a moveable leather bottom, *b b*, and a glass cylinder, *b*, is inserted into it above, all except the glass being encased in brass. In the bottom of the brass box works a screw, C, on the upper end of which the leather rests, so that by elevating or depressing this screw, the bottom of the cistern and, with it, the cistern level of the mercury can also be raised or depressed at pleasure. A small ivory pin, *p*, ending in a point, is fixed to the upper frame of the cistern, and when an observation is made, the surface of the mercury is made to coincide with the point of the pin as the standard level from which the barometric column is to be measured. The tube of the barometer, the upper part of which is shown in the second figure, is enclosed in one of brass, which has two directly

opposite slits in it for showing the height of the column, and on the sides of these the graduation is marked. A brass collar, *d d*, slides upon the

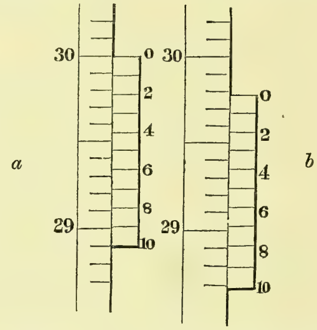


tube with a vernier, *v v* (see *below*), marked on it for reading the height with the greatest exactness, and in this two oblong holes are cut, a little wider than the slits in the brass tube. When a reading is taken the collar is so placed that the last streak of light is cut off by the two upper edges of the holes, or until their plane forms a tangent to the mercurial surface. By this means the observer is sure that his eye is on a level with the top of the column, and that the reading is taken exactly for this point. Fortin's barometer is generally arranged so as to be capable of being made portable, in which case the screw, C, is sent in until the mercury fills the whole cistern, by which means the air is kept from entering the tube during transport, the leather yielding sufficiently at the same time to allow for expansion by increase of temperature. It packs in a case which serves as a tripod when the instrument is mounted for use. On this tripod it is suspended about the middle, swinging upon two axles at right angles to each other, so that the cistern may act the part of a plummet in keeping the tube vertical—the position essential to all measurements" (Chambers's 'Encyclopædia').

How to Manage a Barometer. It is of the first importance to have the instrument hung in a vertical position. This is best effected by means of a plummet line. It should be placed in a good light, but protected from direct sunlight and also from rain. If air should accidentally find its way into a common cistern barometer, it may be got rid of by first fixing the ivory piston, so as to prevent the escape of the mercury; then by means of the screw raising the mercurial column nearly to the top of the tube; and lastly, by slowly inverting the instrument and tapping the cistern gently, so that the air may ascend to the cistern and thus escape. In transporting a barometer from place to place it is best to carry it by hand; if it is packed, the float must be firmly fixed and the mercurial column raised by means of the screw, so as to prevent any escape of the mercury.

Reading the Barometer. The mercury in the cistern must first be brought by means of the screw to the 'zero,' and then the vernier must be screwed up so that its horizontal edge is level with the mercurial surface. The vernier is an instrument for reading off the graduated scale of the barometer correctly to $\frac{1}{100}$ or $\frac{1}{500}$ of an inch.

Buchan gives the following description of the vernier and of the method of using it:—" It con-



sists (see figures *a* and *b*) of a piece similar to the scale of the barometer along which it slides. It will be observed from figure *a* that ten divisions of the vernier are exactly equal to eleven divisions of the scale, that is, to eleven tenths of an inch. Hence each division of the vernier is equal to a tenth of an inch, together with a tenth of a tenth, or a hundredth, or to ten hundredths and one hundredth, that is, to eleven hundredths of an inch. Similarly two divisions of the vernier are equal to twenty-two hundredths of an inch, which expressed as a decimal fraction is 0·22 inch; three divisions of the vernier are equal to 0·33 inch, &c. Suppose the vernier set as previously described—that is, having the zero line of the vernier on a level with the top of the convex surface of the mercury in the column. If the vernier and scale occupy the relative positions as in figure *a*, then the height of the barometer is 30·00 inches; but if they stand as in figure *b*, we set about reading it in this way: (1) The zero of the vernier being between 29 and 30, the reading is more than 29 inches, but less than 30 inches, and we obtain the first figure 29 inches. (2) Counting the tenths of an inch from 29 upwards, we find that the vernier indicates more than seven tenths and less than eight tenths, giving the second figure seven tenths, or 0·7 inch. (3) Casting the eye down the scale to see the point at which a division of the scale and a division of the vernier lie in one and the same straight line, we observe this to take place at line 9 of the vernier; this gives for the last figure nine hundredths or 0·09 inch, and placing all these figures in one line we find that the height of the barometer is 29·79 inches. This sort of vernier gives readings true to the hundredth of an inch. If the inch be divided into half tenths or twentieths, and twenty-five

divisions of the vernier equal twenty-four divisions of the scale, it follows that the difference of these divisions is two thousandths of an inch."

A still more finely divided vernier is generally used with the best barometers, and though a little troublesome to read at first, yet, if the method of reading the simpler one just described be understood, the difficulty will be easily overcome.

The form of vernier most frequently used, is one in which 25 divisions of the vernier correspond to 24 of the smallest divisions of the scale (each usually $\frac{1}{20}$ inch if the scale is in inches). This vernier is read upward from the zero, which is at the bottom of its scale.

Uses, &c. The barometer is employed for ascertaining the amount of atmospherical refraction in astronomical calculations, for measuring altitudes, and, as alterations in the weather generally accompany variations of atmospheric pressure, as a weather indicator. At sea it is of great value in foretelling gales, which are generally preceded by diminution of atmospheric pressure and consequent fall of the mercury column. For foretelling the weather, the indications, as read off from the scale of the instrument, are generally sufficiently accurate; but in all observations connected with meteorology, altitudes, astronomy, &c., certain corrections must be made. The height of the mercury and the length of the scale by which its height is measured are influenced by the temperature of the air by which it is surrounded. The height of the mercury column is also sensibly affected by capillary attraction, unless the diameter of the tube be above half an inch, when the capillary error becomes negligible; and also by the pressure of the mercury vapour in the upper part of the tube. This last correction is slight, but increases with the temperature. The following is a detailed account of the principal corrections:

Barometric Corrections:

1. For CAPILLARITY:—This applies to all cistern-barometers formed of tubes of very small diameters, owing to the mercury assuming a convex surface in the tube. As the tube increases in diameter the depression of the mercury lessens, as shown in the table below. Siphon barometers that have each of their legs of equal size require no correction, as the depression is equal at both ends.

TABLE *of Barometrical Corrections for* CAPILLARITY, *from the* 'Encycl. Brit.'

Diam. of Tube.	Depression.
·10 inch.	·1403 inch.
·15 "	·0863 "
·20 "	·0581 "
·25 "	·0407 "
·30 "	·0292 "
·35 "	·0211 "
·40 "	·0153 "
·45 "	·0112 "
·50 "	·0083 "
·60 "	·0044 "
·70 "	·0023 "
·80 "	·0012 "

2. For TEMPERATURE:—This depends on the expansion of the mercury, and of the scale on which the divisions are marked. The correction for expansion of the mercury is—Subtract 1-10000th part of the observed height of the barometer for every degree of F. above 32° at the time of the observation. Or—

$$(\text{obs. } t.—32) \times \text{obs. } h. \times {\cdot}0001 = \text{corr. req.}$$

If temperatures C. are used, the correction is for temperature t—

$$\text{obs. } h. \times {\cdot}00018018 \times t.$$

Besides the correction for expansion of the mercury there is one for the alteration in length of the scale. If that is brass and is correct at 0° C., the correction is for temp. F.—

$$n(t-32) \times {\cdot}00008967,$$

and for temp. C., $nt \times {\cdot}0001614$, where n is the actual reading of the scale. The reading of the scale *plus* this correction gives the observed height h used in the previous correction.

3. For CAPACITY:—If the level of the mercury in the cistern cannot be brought always to the same point of the scale, another correction, called the capacity correction, is necessary. This correction is of amount $\frac{ah}{A}$, where h is the rise or fall of the summit of the mercury column, and A, a, the areas of the cistern and tube respectively. This correction (taken negative in the case of a fall) is to be added to the height of the summit of the column above the zero or neutral point.

A special temperature correction caused by the alteration of volume is necessary for barometers of this class.

4. For variation of gravity with latitude and with height above the sea level. We shall suppose that the standard pressure given by a column of any height is that due to the column at sea level in Lat. 45°. Let h be the height uncorrected for this error, h_0 the corrected height, ϕ the latitude, and d the distance above the sea-level in feet, then the correction is given by the equation—

$$h_0 = h(1 - {\cdot}0026\cos 2\phi - {\cdot}00000066d).$$

Measurement of Heights by the Barometer. When a barometer is at the foot of a mountain, the pressure it sustains is greater than that to which it is subjected at the top, by the weight of a column of air, of unit cross-section, intervening between the top and the bottom.

The height can be obtained from the following table by calculating the number of feet which must have been ascended to cause the observed fall; and then making a correction for temperature by multiplying the number obtained from the table, which may be called A, by the following formula, in which t is the temperature of the lower and t' that of the upper station, both taken in the Centigrade scale:

$$1 + \frac{t + t'}{2} \times {\cdot}00366.$$

A mathematical formula is easily obtained for finding very nearly the true height of a mountain from barometrical and thermometrical observations made at its base and summit. Let p_1, p_2

be the barometric pressures at heights x_1, x_2 (in centimetres) above a mean level; then—

$$x_2 - x_1 = 1840000\ (1 + \cdot 00366t)\ (\log p_1 - \log p_2)$$

where t is the temperature in Centigrade degrees, and the logarithms are common logarithms to the base 10. If the temperatures are different at top and bottom, the arithmetic mean of the two should be taken for t.

To lower the barometer	from	31	in.	to 30	=	857	feet	must be ascended.
"	"	30	"	29	=	886	"	"
"	"	29	"	28	=	918	"	"
"	"	28	"	27	=	951	"	"
"	"	27	"	26	=	986	"	"
"	"	26	"	25	=	1025	"	"
"	"	25	"	24	=	1068	"	"
"	"	24	"	23	=	1113	"	"
"	"	23	"	22	=	1161	"	"
"	"	22	"	21	=	1216	"	"
"	"	21	"	20	=	1276	"	"
"	"	20	"	19	=	1341	"	"
"	"	19	"	18	=	1413	"	"

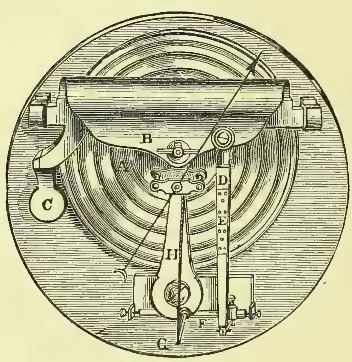
Fortin's and Gay-Lassac's barometers are employed for measuring heights. The aneroid (see *below*) can be used for altitudes reaching to 5000 feet. A delicate instrument will register for even so small an ascent as 4 feet.

The Barometer as a Weather-glass. Generally speaking, when the mercurial column in the barometer falls, 'rain' is indicated, and 'fair weather' when it rises. When it remains steady, a continuance of the weather at the time is regarded as the forecast; when low, the weather is generally broken or bad; and when high, it is fair and settled. A storm is usually preceded by a sudden fall in the mercurial column, the violence of the storm being generally greater the more sudden the fall. An unsteady barometer indicates an unsettled condition of weather, whilst a gradual change in it indicates the approach of some permanent condition of it. The state and direction of the wind has also to be taken into consideration when studying the changes of the barometer, and forms an important element in the calculations of the meteorologist, each different wind indicating variations of weather.

One of the reasons assigned for the mercurial column in the barometer being lower in wet than in fine weather is that, so long as water remains in the air in the form of elastic vapour, its pressure assists in supporting the barometric column; but that when the aqueous vapour is precipitated in the form of rain, this pressure is removed, and the column therefore falls.

The correspondence between wet and fine weather and an elevation and depression of the barometer seems, however, equally if not more dependent on the nature of the winds than on the preceding cause. "In Western Europe the south and south-western winds, which are the rain-bringing winds, are warm winds. Now, a column of warm air to be of the same weight as one of cold air must necessarily be higher, but this cannot well be the case in the atmosphere, for no sooner does the warm column rise by its lightness above the surrounding level of the upper surface of the aërial ocean, than it flows over and becomes nearly of the same height as the cold air around it. The interchange taking place less interruptedly, and consequently less slowly, in the higher strata than in those near the ground, it is some time before the equilibrium, thus disturbed, is restored; and meanwhile the barometer keeps low under the pressure of a rarer atmospheric column. On the other hand, the northerly and easterly winds, being comparatively cold and dry, are accompanied by fair weather and a high barometer. It is thus to the warmth, and not to the moisture of these winds, that the pressure is to be ascribed" (Chambers' 'Encyclopædia').

Barometer, An'eroid. An instrument invented, or at least perfected, by M. Vidi, of Paris, in which the pressure of the atmosphere is measured without the employment of a fluid, as in the ordinary barometer. (An instrument founded on the same principle, and of nearly similar construction was described by M. Conté, in 1798, in the 'Bull. des Sci. Nat.', t. i, No, xiii, p. 106.)

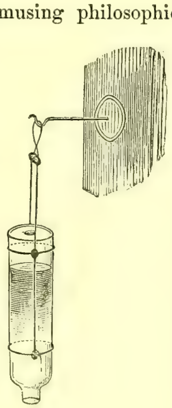


Externally it somewhat resembles in appearance a carriage clock or a ship's chronometer; internally it consists of a small air-tight cylindrical box, formed of thin corrugated copper plates, and partially exhausted of air, the sides of which yield to the pressure of the atmosphere; the effect being regulated by a spring, multiplied by a system of levers, and ultimately recorded by the index on a graduated dial. Compensation for changes of temperature are self-effected, with almost perfect accuracy, by the elastic force of the spring being so adjusted to that of the air in the cylinder, that the loss of force in the one and

the increased expansive force of the other shall, independently of changes of atmospheric pressure, preserve the lever in equilibrium.

The indications of the aneroid barometer closely correspond to those of the mercurial barometer at ordinary ranges, the differences never exceeding ·01 of an inch. It is so extremely sensitive that an ascent or descent of only a few feet is distinctly indicated by it, whilst its portability adapts it for service in situations for which an ordinary barometer is unfitted. On the other hand, it is liable to move by jerks, and the elasticity of the spring, and, therefore, also the zero-point of the scale, have been found to be sometimes affected by time and a rough journey. On this account it is necessary to compare it occasionally with some standard mercurial barometer, to determine its amount or rate of variation, if any.

Barometer, Phial. This amusing philosophic toy is made by cutting off the rim and part of the neck of a common glass phial with a file. The phial is then nearly filled with water, either pure or tinged blue or red; and the finger being placed on its mouth, it is inverted, and suspended in a vertical position by means of a piece of twine or wire, when the finger is withdrawn (see *engr.*). In dry weather the under surface of the water remains level with the neck of the bottle, or even concave; in damp weather, on the contrary, a drop appears at the mouth and continues enlarging until it falls, and is then followed by another in the same way.



BAR'OSCOPE† (-skōpe). [Eng., Fr.] *Syn.* Barosco'pium, L. A barometer; sometimes applied to the wheel-barometer of Hooke.

BAR'RAS. The concrete resinous exudation from the bark of fir trees. That from *Pi'nus marit'ima* is called galipot.

BARSE. [Provincial.] The common perch.

BAR'WOOD. A red dye-wood imported from Angola and other parts of Africa. Produced by *Baphia nitida*, Afzel, a West African shrub, 8 or 10 feet high. It closely resembles cam-wood and sanders-wood in its colouring matter, being of a resinous nature and scarcely soluble in water. It contains a crystalline principle called *baphinin.* In *dyeing*, this difficulty is obviated by taking advantage of the strong affinity existing between it and the proto-salts of tin and iron. Thus, by strongly impregnating the goods with protochloride of tin, either with or without the addition of sumach, according to the shade of red desired, and then putting them into a boiling bath containing the rasped wood, the colour is rapidly given out and taken up, until the whole of the tin in the fibres of the cloth is saturated, and the goods become of a rich bright hue. In like manner the dark red of bandana handkerchiefs is commonly given by a mordant of acetate of iron followed by a boiling bath of this dyestuff. See Dyeing, Mordants, &c.

BASALT' (bă-sŏlt'). [Eng., Ger.] *Syn.* Basal'tes (-săl'-tēz), L.; Basalte, Fr. In *geology*, &c., a species of trap-rock, essentially composed of the minerals felspar and augite. It is of a fine compact texture, of a dark green, grey, or black colour, and usually occurs in regular columns, of which the Giants Causeway and the Island of Staffa furnish magnificent examples. It is fusible, and when rapidly cooled forms a dark brittle glass, but when slowly cooled retains its original beauty and hardness almost unimpaired. Messrs Chance Brothers, of Birmingham, have availed themselves of this property to apply it to decorative and ornamental purposes. Their process is to melt the material (rowley-rag, as beside ordinary basalt, greenstone, whinstone, and other similar minerals, possess the same property) in a reverberatory furnace, and, when sufficiently fluid, to pour it into red-hot moulds of sand encased in iron boxes. The corresponding adj. is basalt'ic (-sŏlt'-; basal'ticus, -săl'-, L.; basaltique, Fr.).

BASE. [Eng., Fr.] *Syn.* Ba'sis (pl., ba'ses), L.; Grund, Grundfläche, Ger. In *chemistry*, the name 'base' was given in 1744 by the celebrated French chemist Rouelle to those bodies which reacted with acids to form salts. "The name has sometimes been applied to metals, as well as to the oxides and hydroxides of metals; at other times it has been confined to compounds of the metals with hydrogen and oxygen; at all times the conception underlying the name has been that of a substance which, while chemically very unlike an acid, reacts with acids to form salts. . . . A base may be either (1) a metallic oxide; (2) a metallic hydroxide or an allied compound such as $N(C_2H_5)_4OH$; or (3) ammonia or a derivative thereof, *e. g.* $NH_2C_2H_5$, $N(CH_3)_3$, &c." (Watt's 'Dict. of Chem.,' 2nd ed.). There are also a variety of other organic bases besides those just mentioned, *e. g.* the alkaloids, amines, amides, pyridine, &c. We speak—somewhat loosely—of strong and weak bases, just as we do of strong and weak acids. For a detailed account of this subject the reader is referred to 'Watt's Dictionary.' He should also read, in conjunction with this, the articles Acid and Salt.

BASICITY. See Acid.

BAS'IL (băz'-). *Syn.* Sweet bas'il, Cit'ron b.; Basil'icum, L.; Basilic, Fr.; Basilikum, Ger. The *Oc'ymum* (ŏs'-) *basil'icum*, Linn., an annual aromatic herbaceous plant, of the Nat. Ord. Labiatæ (DC.). It is a native of India, but is largely cultivated in every part of Europe as a pot-herb. Leaves strong-scented; popularly reputed emmenagogue; much used to flavour salads, soups, &c., especially in French cookery. Mock-turtle soup derives its peculiar flavour from this herb; as also did the original Fetter-lane sausages, once so highly esteemed by cockney gourmands. In India it is commonly employed as an anodyne in childbirth.

Bas'il (băz'-). *Syn.* Bas'an; Basane, Fr. A sheepskin, tanned; particularly one dressed on the grain side, for bookbinding.

BASIL'ICON. See Cerates and Ointments.

BAS'KET (băs'-). *Syn.* Coph'inus (kŏf'-),

L.; PARIEB, CORBEILLE, &c., Fr.; KORB, Ger. BASKETS are generally STAINED or COLOURED with the simple liquid dyes used for straw or wood; and that, for variegated work, the twigs, after being carefully peeled, washed and wiped dry or slightly air-dried, are stained before being woven. See OSIERS, &c.

BASS‡. [Provin.] The linden tree; also a hassock or mat made of its inner bark. See BAST.

BASSIA BUTYRACEA. A tree growing in the sub-tropical Himalayas. The seeds yield by expression a concrete oil, known by the name of *Fulwa Butter*, which does not become rancid by keeping. It is held in high esteem in India as an external application in rheumatic and other painful maladies.

BAS'SORIN (-rĭn). *Syn.* BASSORI'NA, L. A substance first noticed, by Vauquelin, in *Bas'sora gum.* See GUM, INSOLUBLE, TRAGACANTHINE, &c.

BAST (băst). *Syn.* BASS (which *see*). The inner bark of the linden tree or teil tree; also matting, &c., made of it.

BAS'TARDS (-tărdz). *Syn.* BAS'TARD SUG'AR (shŏŏg'-), PIECES, &c. In *sugar-refining,* impure or damaged sugar resulting from the heat and chemicals used in the process of manufacture, and which will not pay for purifying. Brass tubing which is not of the standard size, but which fits tightly into standard sizes, is called bastard tubing.

BA''SYL (bāse'-ĭl). In *chemistry,* any simple or compound body acting as a basic radical.

BATATA (*Convolvulus batatas,* or SWEET POTATO). This is a native of the East Indies, but is now cultivated in all tropical and sub-tropical countries for the sake of its tubers, which are highly esteemed as an article of food. They are eaten either roasted or boiled, and are sweet, wholesome, and nutritious, although somewhat laxative.

In some parts of America the Batata, next to maize, forms the principal diet of the poorer classes. The plant was introduced into England by Sir Francis Drake and Sir John Hawkins; but they do not bear the cold of our winters, and if grown here are raised in hothouses, where they may be obtained without difficulty varying from 1 lb. to 2 lbs. in weight. They thrive better in the south of Europe. The tubers contain about 32% of solid matter, 16 of which is starch, 10 sugar, 1·5 albumen, 1·1 gum, 0·3 fat, 2·9 mineral matter. The leaves are used as a boiled vegetable.

BATH (bahth). *Syn.* BAL'NEUM, L.; BAIN, Fr.; BAD, Ger., Sax. A place for bathing; a vessel or receptacle, natural or artificial, containing or adapted to contain water, and used to bathe in. In *architecture* and *hygiene,* a building fitted up for and appropriated to bathing.

Constr., &c. Here one of the first subjects which must engage our attention is the selection of the material of which the bath is to be formed. For FIXED BATHS polished white marble has always been in favour, owing to its cleanliness and beauty. For this purpose, slabs of sufficient thickness and free from flaws or cracks should be chosen; and they should be securely and properly bedded in good water-tight cement, in a well-seasoned wooden case. The objections to marble, independent of its costliness, are, that it is apt to get yellow or discoloured, and to lose its polish, by frequent and careless use; and that the restoration of its surface to its original purity is a matter of considerable expense and difficulty. It is also only fitted to contain water with, at the most, soap, weak alkalies or alkaline carbonates, aromatics, or neutral organic principles; and cannot be employed with water medicated, however slightly, with acids, sulphurets, iodine, chlorine, salines (others than those just named), or calorific substances. As a cheaper material thick slabs of Welsh slate are often substituted for marble; but even this substance is attacked by chemicals, though much more slowly. A lining of large Dutch tiles is sometimes used; but here the joints are very apt to leak. For baths adapted to all the requirements of health and disease, and which are at the same time durable and comparatively inexpensive, we must, therefore, seek further. Porcelain, glass, and hard glazed stoneware have been proposed, and are even sometimes used for baths; but they possess the disadvantages of being fragile, and very liable to crack when filled with hot water in cold weather. Wedgwood-ware is very beautiful and durable; but is expensive, and baths formed of it can only be obtained on special order. Stourbridge-ware, as produced of late years, is the only product of the potter's art that appears entirely to meet the case; but even this yields in durability to enamelled iron as a material for baths adapted to all liquids and temperatures, and to rough or careless usage. The better qualities of POR'TABLE BATHS are generally made of copper. Stout tinned or galvanised iron, and even stout block-tin thickly covered with waterproof paint or japan, are also employed; but, though less expensive than copper, they have the the disadvantage of being much less durable. All these substances are, however, readily acted on by chemicals. A durable and cheap portable bath, adapted to all purposes, must, therefore, like a fixed one, be made of one or other of the materials already noticed. For MED'ICATED BATHS large wooden troughs are frequently employed, particularly for acidulated, ioduretted, and sulphuretted baths.

The bath is emptied, and excess of water removed, by a grated aperture in the bottom, also stopped by a cock which, like the former, has handles or keys so placed as to be accessible to the attendant outside the bath-room, as well as to the bather, whilst the danger of overflowing is obviated by a 2-inch waste pipe, opening into the bath at about 2 inches from the top.

The construction of the outlets for the water is a matter of some consequence. The simplest and, perhaps, the best plan is to have a large circular opening—2 inches in diameter, at the lowest point of the bath—which can be closed by a well-fitting brass plug. Valves, however well made, are unsatisfactory, and especially those which depend for their action on perfect fitting. A coned plug ground into its bed, in a lathe, is in common use, but it must be remembered that a single hair, a piece of thread, and such-like matters, will effectually prevent its closing properly, and will

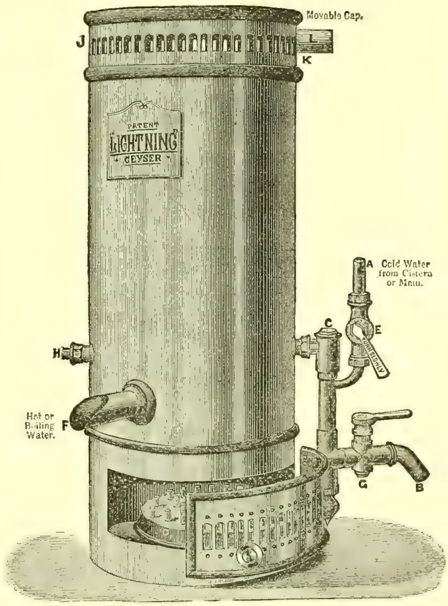
cause it to become a constant source of annoyance, either leaking continually or jamming in such a way that the water cannot be removed. In this, as in other household appliances, it must be remembered that servants will not always put them to their proper use, and many things find their way into a bath which the maker never intended to be put there, so that the simplest and most accessible contrivances are the best. The bath waste-pipe should be carefully disconnected from the drains and should fall on to an open grating outside the house, and this grating should be properly trapped.

The bath itself should be invariably set in a water-tight zinc or lead tray, 2 or 3 inches deep, so that in case of overflow the water may not destroy the ceilings of rooms below. This tray should have a pipe leading to the outside of the house, and opening in some convenient place, so that water running from it may not cause damage; further, its position should be such that a cane or wire may be easily passed through it to remove any obstructions.

The situation and the minor details connected with the comfort and convenience of the bath, must greatly depend on the character of the building and the sum to be devoted to the purpose. When possible, the bath-room should always be on the same floor as the bedrooms, of easy access to them, and so situated and arranged that a plentiful and constant supply of pure water can be ensured, and the waste water removed without trouble or inconvenience. The basement story should always be avoided; for, as observed by Dr Ure, there is a coldness and dampness belonging to it, in almost all weathers, which is neither agreeable nor salubrious.

Apparatus for Heating. The arrangements for supplying cold and hot water must necessarily greatly depend on circumstances, and the quantity required. For a single fixed bath, or even for two or three of them, the common circulating water-heater or boiler, placed in some apartment on a rather lower level than the bath, is, perhaps, the most convenient; but where this is not attainable the water may be run, by means of a pipe, from a boiler situated on a somewhat higher level. In either case a supply of cold water must also be at hand, and conveyed in a like manner, to enable the bath to be reduced to any required temperature. On the large scale, as in our public baths, where numerous baths are in constant use during the day, the hot water is best supplied from a large cistern somewhere above the level of the bath-rooms, and which is heated by a coil of pipe supplied with high-pressure steam from a boiler situated on a lower level, as the ground floor or basement. The hot and the cold water, conveyed by separate pipes of about $1\frac{1}{2}$ inches diameter, unite in a two-way cock close to the bath, so as to enter it together, by which only *one* aperture in the end of the bath is required for the purpose.

As many houses are not fitted with a circulating boiler and the cost of installation is considerable; and further, as some persons object to them because of the supposed risk of explosion, numerous contrivances have been invented for the supply of considerable quantities of boiling water at short notice. Of these the form known as the 'Geyser' is perhaps the best. This apparatus consists essentially of a copper vessel heated by gas in such a way that the heat from the burners is caused to circulate through the water, so that very little is lost, and the quantity heated per minute is very considerable with a very moderate consumption of gas. They have this advantage in addition, that a geyser can be used in any place which is furnished with a constant supply of water, or where there is a cistern of sufficient capacity to hold something more than the quantity actually required for use at one time. They occupy small space, and are easily moved from one place to another. They are made in various sizes; to deliver from one pint to a gallon of boiling water per minute. The general arrangement will be clear from the annexed cuts.



The cold water from cistern or main enters at the union, A, and the gas at the union, B. In passing through the 'Dual' valve, C, the water admits of a full supply of gas to the burner, D. If the water is either shut off by the tap, E, or the supply fails from any other cause, the supply of gas is instantly discontinued entirely, or else reduced to harmless quantity. After passing the valve and admitting gas to the burner the water flows through the various chambers in the geyser, absorbing almost the whole heat from the flame, and issues at the spout, F, at any temperature required, from tepid to boiling, according to the thickness of the stream. A gas tap, G, is always added, and may be used as a regulator or to shut off supply of gas entirely, if only cold water is wanted. If the taps are required on the other side of the geyser, they can be unscrewed and fixed to the union, H, which is placed there for the special purpose.

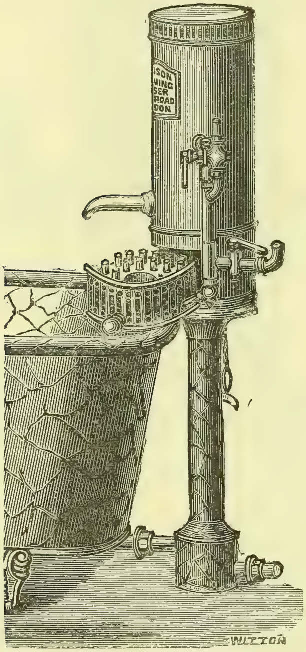
J K is a moveable cap, sometimes perforated with small holes, as shown, but now more fre-

quently closed; it is fitted with a socket, L, which can be turned in any direction; through this socket the products of combustion issue, and may be carried by means of a straight pipe through the partition or wall of bath-room, or by means of an elbow through the ceiling into a loft, or out into the open air.

As the water is heated by the luminous white flames (and not the Bunsen burner) the products are without smell. It is absolutely necessary that the burnt air should be conveyed *outside the bath-room,* as the quantity of carbonic acid gas produced in warming the 30 gallons of water required is too large to be safely confined in a small room.

This applies to all geysers of whatever manufacture, and however heated. The white flame is safer than the Bunsen burner, but no burner is safe without a ventilating pipe.

The burner is so constructed that if any of the jets become worn or injured they may be renewed without skilled labour. The jets are the ordinary Bray's burners, which may be bought anywhere, and can be replaced with ease.

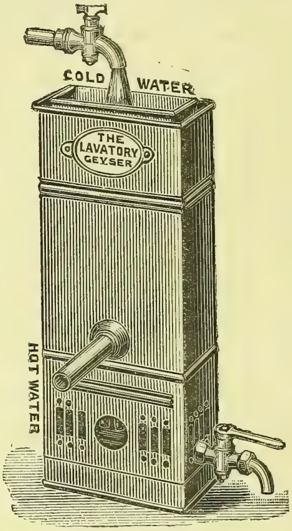


Cut showing position of geyser when arranged for supplying a bath.

Circulating boilers heated by gas are also constructed by the makers of the geyser (see *engr.*).

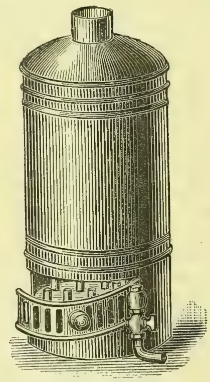
Varieties, Therapeutic Uses, &c. For therapeutic purposes baths may be divided conveniently into liquid baths and air-baths, and each of these again into simple and composite, medicated or artificial.

Simple Baths.—*The Cold Bath.* By this is to be understood the immersion of the body in water at a temperature below 70° F.; water at any temperature below 50° F. is to be considered as very cold. On entering a cold bath the first



Small geyser for lavatory use.

sensation is one of cold sufficient in many cases to produce shivering, and perhaps a slight gasping



Gas circulating boiler.

for breath. After two or three minutes' immersion the temperature of the skin will be somewhat lowered; there will be some numbness of the limbs, and the pulse rate will be diminished by 10 to 20 beats per minute. On coming out of the bath reaction sets in, more or less quickly according as the period of immersion has been long or short, the skin is flushed and its temperature is raised. The physiological explanation of this is that the cold at first contracts the capillaries of the skin, and the blood is driven from the surface of the body to the interior; in this way the pressure of the blood in the internal vessels is increased, and for a time there is an increase in the elimination of urea and carbonic acid from the system. Sudden immersion in cold water produces in this way a considerable strain on the

heart and blood-vessels, and should, therefore, only be indulged in by those whose hearts are sound and blood-vessels elastic. Brief immersion is perhaps the best; immersion for ten minutes or a quarter of an hour increases both the action and the reaction; a longer period is apt to remove so much heat from the body as to produce depression only. If the cold bath take the form of a plunge into a river or other large body of water in which swimming may be practised, the effect is modified, and a longer immersion may be tolerated with much less risk of harm. Cold bathing soon after rising in the morning is a most excellent stimulant to the nervous system to those who are vigorous and healthy, but should not be indulged in by those on whom it produces a sense of weariness and lassitude, as these may be taken as signs that the shock has been somewhat more than the individual is capable of bearing; in these cases the temperature should be slightly raised by addition of hot water.

Tepid Baths. A bath is said to be tepid when the temperature of the water is between 85° F. and 95° F., that is to say, not exceeding a little below the temperature of the human body. They are, in fact, neither cold nor warm to the skin; they produce no excitement of the nervous system or effect upon the blood-vessels of the skin; as there is no action, so there is no reaction, and the pulse and temperature remain unaltered.

Warm Baths. When the temperature of the water exceeds 96° F. a bath may be said to be warm; up to 104° F. there is no shock to the system, the pulse is slightly increased, as is the flow of blood to the capillaries of the skin; above 104° F. and up to about 114° F. the effects become gradually more marked, both the pulse and respiration are quickened, the skin is flush, and, on coming out, will perspire freely. Too long immersion in hot water has an exceedingly enervating and debilitating effect, and should not be indulged in even by the healthy; whilst the feeble, and especially those whose circulatory systems are not perfectly sound, should be very careful to avoid the use, or rather the abuse, of too hot baths. Persons who are greatly fatigued, as after severe muscular exercise, should not plunge into cold water, as the nervous system being already excited and somewhat exhausted is not in a fit state to withstand the shock, and harm may ensue; a tepid bath is the best to use under these circumstances. It must not be forgotten that the vigorous use of a towel after the bath is perhaps as important and in many cases *more* important than the bath itself. The stimulation of the skin so produced removes any depression which the cold water may have caused, and allows the body to return more or less slowly to its normal state.

Vapour Baths. A vapour bath is one in which the body instead of being in direct contact with water is exposed to the action of its vapour. This may be accomplished in one of two ways: by entering a room filled with vapour, as in the Turkish bath, or by a suitable arrangement exposing only a portion of the body to its action. The former can only be done where a properly constructed room is available; the latter may be very simply arranged by placing under a chair an earthenware vessel containing hot water, and in this one or two red-hot bricks. The patient then sits on the chair and is covered up with blankets or other suitable coverings, and receives the full benefit of a vapour bath. A large lump of quicklime, set in a pan or an old iron pot and sprinkled with a little water, or else wrapped up in a thick coarse towel which has been previously soaked in water, may be substituted for the hot bricks, and often advantageously so. The slaking of the lime and the consequent evolution of vapour may be kept up or renewed, when necessary, by sprinkling on a little more water. This forms the 'POOR MAN'S VAPOUR BATH' of the French. Vapour baths induce profuse perspiration, and cleanse the skin in much the same manner as hot water, only more powerfully. A higher temperature can be tolerated than when hot water is used, but it cannot be continued so long, as the vapour interferes with the radiation of heat from the body: the maximum temperature which can be borne is about 122° F. In a Russian bath the sweating induced is such that a person may lose from $\frac{3}{4}$ lb. to 3 lbs. in weight; the skin is further stimulated by slight switching with a bundle of twigs and subsequent use of the cold douche.

Hot-air Baths. The simplest plan for giving a patient a hot-air bath is to put him in bed, with a cradle or other arrangement over him so placed as to prevent contact of his body with the bedclothes, and to introduce the hot air beneath this by means of a suitable apparatus. The following brief account of the arrangements adopted in establishments fitted specially for this form of bathing, and which differ but little from those in use among the ancient Romans, will be interesting:—The bather first strips and enters the TEPIDARIUM, in which the temperature varies from 113°—117° F., and there remains from 25 to 40 minutes, during which time a profuse sweating occurs. He then removes to the CALIDARIUM, in which the temperature is maintained by means of hot-air pipes let into the walls at from 133°—140° F.; here he remains until the sweat runs down his skin—a quarter of an hour is usually sufficient to effect this; he is then rubbed by an attendant with a woollen glove. This done he enters the LAVACRUM, where he has water at a temperature of 80°—86° F. poured over him, is soaped all over, and is again rubbed down; after this he goes to the FRIGIDARIUM, lies on a couch until the skin is perfectly dry, which may occupy half an hour, when he dresses and leaves the bath greatly refreshed. Hot-air baths are useful for the cure of catarrhs, of rheumatic and neuralgic pains, and sciatica; they have also been employed for the cure of obesity. They are useful for general hygienic purposes, but should not be used too indiscriminately. The local application of hot air and vapour is often of value in rheumatism or in cases of thickened joints.

The ranges of the temperature of water appropriate to the respective baths, according to the common nomenclature, are shown in the following table.

General Remarks. The importance, and indeed the absolute necessity of frequent personal ablution, has been already insisted on and explained. But however important and beneficial the use of water in this way may be, the effects

Name.	Temperature (Fahr.).
Cold bath	33° to 75°
Temperate bath . . .	75 „ 82
Tepid bath	82 „ 90
Warm bath	90 „ 98
Hot bath	98 „ 112

arising from the immersion of the body in that liquid, as in the practice of bathing, are far more extensive and complete. What the one does usefully but not completely, the other accomplishes readily, satisfactorily, and perfectly. There is no absolute succedaneum for the entire bath. Its physiological effects are peculiar to itself, and of the utmost importance in pathology and hygiene. The practice of wearing flannel, the daily use of clean linen, the mere washing of the more exposed parts of the body, are but poor attempts at cleanliness, without the occasional, if not frequent, entire submersion of the body in water.

The recommendation of bathing applies chiefly to the warm bath and the tepid bath, which are alike adapted to the delicate and the robust, and to every condition of climate and season. Cold bathing, in this climate, is only suited to the most healthy and vigorous, and can only be safely practised during the warmer months of the year, and in a mass of water sufficient to permit of the heat of the body being maintained by swimming or other active exercise. The plunge and shower baths are partial exceptions to these remarks; whilst sea bathing, for the reasons given elsewhere, comes under another category. This last, "on account of its stimulative and penetrating power, may be placed at the head of those means which regard the care of the skin; and it certainly supplies one of the first wants of the present generation, by opening the pores, and thereby re-invigorating the whole nervous system." "Besides its great power in cases of disease, it may be employed by those who are perfectly well, as the means most agreeable to nature for strengthening the body and preserving the health." Another important advantage which sea bathing has over bathing in fresh water is, that persons seldom take cold from indulging in it.

For old people, or those of middle age, the cold bath is not to be recommended, or if taken, considerable caution is required in using it. By such persons, also, bathing in very hot weather, or in the sea, should likewise be prudently practised. For these, the warm or tepid sponge-bath will be found the much safer method.

It sometimes happens that, both with the old and young, the cold bath gives rise to headache, palpitation, shortness of breath, loss of appetite, or great languor. Whenever any of these effects are produced, the bath should be at once given up.

The best time for taking a cold bath or for swimming is in the morning, not too early, but when the sun is well up. Immersion is best practised after a light meal, but not immediately following one. After breakfast, from 10 a.m. to noon, are the preferable hours. Should the bather be unable to swim, when going into the sea or into a river, he should keep briskly moving all the time his body is immersed in the water. If in a room bodily friction must be substituted for exercise. A desirable glow may often be produced by rubbing the body with either a rough towel, a flesh-brush, or a pair of horsehair gloves.

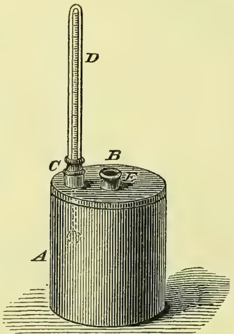
The above remarks are meant to apply only to persons in average health.

Weakly and delicate persons, even without any disease about them, would always do well to consult their medical adviser before taking to cold bathing.

We may add that for bathing to produce its best effects the water should be soft and pure, and good soap sparingly but regularly employed whenever the skin requires it. See ABLUTION and WASHHOUSES.

Bath. In *chemistry*, &c., a vessel or apparatus containing some medium in which the vessel holding the substance to be heated is immersed, instead of being exposed to the direct action of the fire; by which means a limited and uniform temperature may be ensured.

The highest temperature that can be given to any substance contained in a vessel placed in another of boiling water is about 205° or 206° F.; but by adding $\frac{1}{6}$ part of common salt to the bath a heat of fully 212° may be obtained. Baths of fusible metal, saturated solutions of salt, sand, and (on the large scale) steam, are also used for the same purpose. A bath of oil may be safely heated to about 500° Fahr. without suffering decomposition, and will be found an exceedingly appropriate and convenient source of heat in many processes. The simplest and most convenient form of water-bath is that afforded by raising water to the boiling-point in a copper basin placed over a gas lamp, and supporting the vessel to be heated over the basin by means of a circular hoop of copper resting on the top of the basin. By this means the lower surface of the dish or vessel to be heated is brought in contact with the steam. Copper basins, fitted with a series of concentric copper rings, so as to render the basin capable of supporting dishes of different sizes, are made for this purpose.



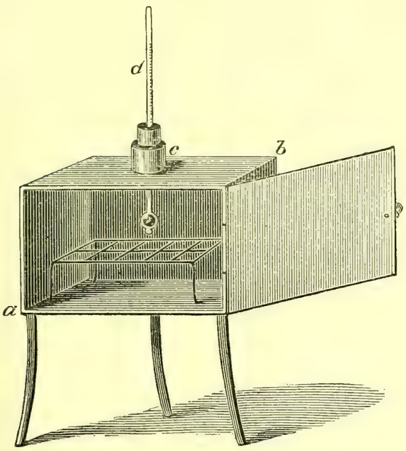
For drying many substances an air-bath is required. The accompanying engr. represents a convenient form of air-bath. It consists of a cylindrical copper vessel (*A*), the cover of which is moveable and has two apertures, the middle one (*E*) serving for the escape of vapour, and the lateral one (*C*) for the insertion of a thermometer. The vessel holding the substance to be heated rests on a ring within the box, supported on a tripod.

A larger air-bath, by means of which several small vessels can be heated at once, is seen below.

Air-baths are sometimes surrounded with a jacket, and may be converted into water or oil baths, according as the jacket is filled with either of the fluids. For a table of boiling-points see EBULLITION.

An air-bath of constant temperature between 100° and 200° C. has been contrived by Sprengel. It consists of an ordinary hot-water oven made of sheet-lead autogenously soldered, and filled with dilute sulphuric acid boiling at the required temperature.

In order that the temperature may remain constant, the water which distils from the dilute sulphuric acid is condensed and allowed to flow back into the bath by means of a worm of



lead cooled by the atmosphere, or a long vertical metal or glass tube. A similar arrangement can easily be attached to any water-bath, and the loss by evaporation thus counteracted.

Bath. In *medicine*, the medium in which the body, or a part of it, is bathed or immersed, for some object beyond that of mere personal cleanliness or enjoyment; the composition, use, or temperature of the medium being generally indicated by some epithet, as in the instances below. When only the last is pointed out, pure water is, of course, intended to be used.

Baths are divided by medical writers into classes, and even minor subdivisions, in a manner which is more ingenious than useful. They are said to be SIMPLE when water or its vapour forms the bath; and COMPOUND when the water or vapour is medicated by the addition of other substances (COM′POUND BATHS; BAL′NEA COMPOS′ITA, L.). The latter class is also subdivided into THERAPEU′TIC BATHS (MED′ICATED BATHS; BAL′NEA MEDICA′TA, B. THERAPEU′TICA, L.) and NU′TRITIVE BATHS (B. NUTRIEN′TIA, B. NUTRI″TIA*, B. NUTRITO″RIA*, L.). Thus, besides the ordinary water and vapour-baths, the medical uses of which are hereafter noticed, we have WINE′-BATHS, MILK′-BATHS, SOUP′-BATHS, &c. (used to convey nourishment, or to sustain the body, as in occlusion of the œsophagus, certain diseases of the stomach, &c.); CHLO″RINE BATHS, SUL′PHUROUS B., MERCU″RIAL B., &c. (used in skin diseases, syphilis, &c.); AROMAT′IC and CHALYB′EATE BATHS (employed as tonics); and ACID BATHS (sometimes used to remove the effects of mercury).

On the Continent a variety of substances are employed to medicate baths, which are seldom or never so used in this country.

The quantity of any medicinal substance used to medicate a bath, for an adult, may be, in general, for each gallon of water employed, about the same as that which is used to form a half-pint lotion of medium or rather weak strength. Thus, taking the quantity of bichloride of mercury to form the lotion at 5 *gr.*, and that of sulphurated potash at $\frac{1}{2}$ *dr.*, the quantity required for a bath of 30 to 40 galls. will be about $2\frac{1}{2}$ *dr.* of the first, and about $1\frac{3}{4}$ *oz.* of the second of these substances. Much, however, depends on the nature of the case, the length of the immersion, the periods of recurrence, and the intended number of repetitions. In the case of very active remedies it will be safest and best to begin with less than (say $\frac{1}{4}$ to $\frac{1}{3}$) the quantity thus indicated.

Medicated baths are, in nearly all cases, taken warm or fully tepid.

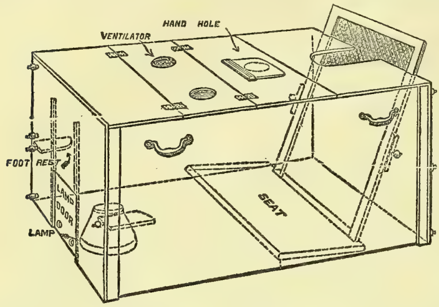
*** In the following baths the quantity of the ingredients ordered, when not otherwise indicated, is that proper for an ordinary full-sized bath for an adult, viz. from 40 to 60 galls. Those which do not contain volatile substances may be used more than once; and many of them several times by adding a small quantity of fresh ingredients to keep up their strength.

Bath, Acid (ăs′-). *Syn.* BAL′NEUM AC′IDUM (ăs′-), L. See HYDROCHLORIC, NITRIC, NITRO-HYDROCHLORIC, and SULPHURIC ACID BATHS (*below*). Enamelled, hard-glazed, or wooden vessels must be used with all of them.

Bath, Air. *Syn.* BAL′NEUM PNEUMAT′ICUM, L.:—*a.* (Cold.) Simple exposure of the body, in a state of nudity, for a short time to the atmosphere. Tonic, anodyne, and sedative; in febrile excitement, nervous irritability, and restlessness accompanied by a quick or full pulse, &c. Safe and often very effective. It will frequently induce sleep when all other means fail.

b. (Hot:—ASSA, A. SUDA′TIO, L.) An apartment to which dry heated air is admitted. Sometimes the arrangement is such that the air is *not* inhaled. Mr Cholmondeley-Pennell's patent air-bath, which is used at one of the London hospitals (see *engr.*) is a very simple and portable form. The heat is supplied by a large spirit lamp of very simple and safe construction, having a large gauze cover so arranged that if upset (which is almost impossible) the lamp is extinguished. The following directions for the use of the bath are given by the makers:—Place the lamp on the ground opposite the sliding door; light the spirit; shut down and *fasten* the gauze cover; place the burner just inside the bath, and close the sliding door. After the bath let the spirit burn itself out. [A strip of flannel twisted round the neck, after the bather is seated, prevents the hot air escaping at the neckhole; and a 'bath-sheet,' *doubled*, for the bath to rest on, effects a similar object as regards the side edges of the 'travelling' bath resting on the floor. A piece of folded flannel, or a towel, hung over

the centre of the top of the wicker back gives additional comfort to the head, and diminishes, if



desired, the amount of heated air passing out at that point. A small folded 'cot' blanket makes a convenient 'cushion' for the seat.] Stimulant; sudorific; more so than even the vapour bath; produces copious perspiration, being, indeed, the most powerful and certain diaphoretic known. It has been advantageously employed in cholera (for which its advocates state that it is almost a specific), congestive fevers, chronic rheumatism, contractions, stiff joints, paralysis, scaly skin diseases, dropsical swellings, and most of the cases in which the vapour bath is usually employed. The temperatures are—as a sudorific, 85°—105° F.; as a stimulant, 100°—130° F. When not inhaled it may be often raised, with advantage, 15°—25° F. higher. See BATH, TURKISH.

c. (Compressed.) Recommended, by M. Tarberie, in aphonia, &c. It has recently been employed in asthma, phthisis, and some other like diseases, with extraordinary success, at Ben Rhydding.

d. (Rarefied.) Applied locally. Revulsive; resembles CUPPING, DRY (which *see*).

Bath, Acid. *Syn.* BALNEUM ACIDUM. Nitric acid, 1½ fl. oz.; hydrochloric acid, 1 fl. oz.; water, 30 galls. (British Skin; Royal Free; St. Bartholomew's Hospitals).

Bath, Al'kaline. *Syn.* AL'KALISED BATH; BAL'NEUM ALKALI'NUM, B. ALKALIZA'TUM, L. Bicarbonate of sodium, 4 oz.; water at 95° F., 30 galls. (University and St Mary's Hospitals). In itch, prurigo, and chronic skin diseases accompanied with dryness and irritation, acute gout, lithic gravel, scurvy, diarrhœa, &c.

Bath, Al'um. *Syn.* BAL'NEUM ALU'MINIS, L. Alum (in powder, or previously dissolved in hot water), ¾ *lb.* to 1½ *lb.*, or even 2 *lbs.* In troublesome excoriations, extensive burns, obstinate vesicular eruptions, diarrhœa, &c.; also in obstinate piles and prolapsus ani. See BATH, ASTRINGENT.

Bath, Ammoni'acal. See HYDROCHLORATE OF AMMONIA BATH (*below*).

Bath, Animal. *Syn.* BAL'NEUM ANIMA'LE, L. The skin or any part of an animal just killed, wrapped round the body or a limb. Once much esteemed; now, happily, disused in this country.

Bath, Antimo''nial. *Syn.* BAL'NEUM ANTIMONIA'LE, L. Tartar emetic, 1 to 2 *oz.* (*Soubeiran*). In lumbago and certain skin diseases; also as a counter-irritant.

Bath, Antipso''ric. *Syn.* BAL'NEUM ANTIPSO''RICUM, L. See BATH, SULPHURETTED (also others).

Bath, Aromat'ic. *Syn.* BAL'NEUM AROMAT'ICUM, L. Balm, chamomile, lavender, mint, rosemary, sage, thyme, with any other like aromatic herbs (at will), of each a handful, mixed together and steeped in a (covered) pail of boiling or very hot water for an hour, and then strained, with pressure, into the bath. Sometimes 2 or 3 *oz.* of sal-ammoniac, a ¼ *lb.* of alum, or 1 *lb.* of common salt, is also added. Occasionally used in cutaneous affections, chronic rheumatism, diarrhœa, dyspepsia, stiff joint, &c.; also in debility arising from loss of blood, spermatorrhœa, suppressions, hysteria, hypochondriasis, &c.

The AROMATIC VAPOUR BATH is made by causing the vapour to pass through the herbs.

Baths, Aromatic Malt. (*J. Hoff*, Berlin.) Wittstein says these consist of coarsely crushed barley malt at six times its selling value.

Bath, Astrin'gent. *Syn.* BAL'NEUM ASTRIN'GENS, L. *Prep.* (*Most.*) Alum, (2 to) 4 *lbs.*; dissolve in boiling water; and add, whey, 6 or 8 pailfuls, or q. s. In extensive burns, piles, prolapsus ani, &c. See BATH, ALUM; BATH, OAKBARK, &c.

Bath, Balsamic. *Syn.* BAL'NEUM BALSAM'INUM, L. Bordeaux turpentine and tar, of each 2 *lbs.* (or of tar alone, 3 to 4 *lbs.*); hot water, 6 or 7 galls.; stir continuously until nearly cold, then add the clear portion to water q. s. to form a bath. In mumps, pruriginous diseases of the skin, eczema, impetigo, &c.

Bath, Barèges (Factitious). *Syn.* BAL'NEUM BARETGINEN'SE (Factitium), L. *Prep.* 1. Crystallised sulphide of sodium, 3½ *oz.*; chloride of sodium, 1½ *oz.*; gelatine (dissolved), 4 *oz.*

2. (*Trousseau* and *Reveil.*) Dry sulphide of potassium, 4 *oz.*; water, 16 *oz.*; dissolve, and add the solution to the bath; then further add, of sulphuric or hydrochloric acid, ½ *oz.*, previously diluted with water, 8 *oz.* In itch, moist skin diseases, chronic diarrhœa, chronic rheumatism, lead colic, &c. See BALLS, WATERS, &c.

Bath, Benzo'ic. *Syn.* BAL'NEUM BENZO'ICUM, L. 1. Benzoin (in powder), ½ *lb.*; water (at 90° F.) q. s. In irritations, hysteria, hypochondriasis, &c. It is also reputed to be freely aphrodisiac. 2. A common warm bath, with a little powdered benzoin laid on a heated plate near the bather, so that the fumes may be inhaled. Slightly soothing or anodyne; in chronic laryngitis, relaxed uvula, &c.

Bath, Bichlo''ride of Mercury. See BATH, MERCURIAL.

Bath, Boric Acid. Boric acid, 2 *lbs.*, tepid water, 10 galls.

Bath, Bran. *Syn.* BAL'NEUM FUR'FURIS, L. Bran, 5 to 7 *lbs.*; boiling water, 2 or 3 galls.; digested together for an hour, or boiled for fifteen minutes; the strained liquid being added to the bath, making up to 30 galls. with water at 95° F. Emollient; in dry and scaly skin disease, and to allay itching and surfacial irritation; also to promote suppuration, &c.

Bath, Bromine. The saline waters of Kreuznach contain bromides. The salts derived from the evaporation of these waters are imported into

this country, and are employed in baths. Or the following substitute may be used: Artificial sea-salt, 11 *lbs.;* bromide of potassium, 4 *oz.;* mix, and let the above be added to a bath containing sufficient water for immersion. The bromine bath is more especially used for tumours of every kind. It requires to be continued for a long time. When the patient does not possess the conveniences for taking the bath, flannels dipped in a strong solution of the salt and wrung out may be applied wet to the abdomen for some hours daily.

Bath, Cam′phor. *Syn.* BAL′NEUM CAM′PHORÆ, B. CAMPHORATUM, L. Camphor, 3 or 4 dr., coarsely powdered, and placed on a plate heated by boiling water, in the bath-room. Anodyne, anaphrodisiac, and diaphoretic; in spasmodic asthma, chronic cough, relaxation of the uvula, ardor urinæ, nervous irritability, &c.

Bath, Carbo′nic. *Syn.* CARBON′IC ACID BATH; BAL′NEUM CARBON′ICUM, B. AC′IDUM CARBONICUM, L.

1. Carbonic acid gas applied, by means of a suitable apparatus, to prevent its being respired. Antiseptic, diaphoretic, and excitant to the vascular system; in amenorrhœa, chlorosis, hysteria, scrofula, cancerous and other ulcers (particularly foul ones), &c.

2. Water, at 50° F., charged with the gas. Powerfully antiseptic and sedative; in foul ulcers, gangrene, &c.

Bath, Chlo″ride of Ammo″nium. *Syn.* BAL′NEUM AMMO″NII CHLORI′DI, B. AMMO″NIÆ HYDROCHLORA′TIS, L. Sal-ammoniac, 2 to 3 *lbs.*, or even 4 *lbs.*, water, 30 galls. In chronic inflammations, glandular enlargements and indurations, chronic rheumatism and affections of the joints, leucorrhœa, chilblains, frost-bites, &c.

Bath, Chlorinated Soda. Solution of chlorinated soda, 1½ *lbs.;* water, 30 *galls.*

Bath, Chlo″rine. *Syn.* BAL′NEUM CHLORIN′II, B. CHLORINA′TUM, L. Tepid water to which a little chlorine has been added. Antiseptic, stimulant, and subsequently sedative and antiphlogistic; in itch, foul and gangrenous ulcers, chronic liver affections, &c. Chlorinated lime is commonly substituted for chlorine.

2. (*Magendie; Wallace.*) Chlorine gas (obtained from salt, 1½ *oz.;* oil of vitriol and water, of each, 1 *oz.;* and black oxide of manganese, ½ *oz.* to 1 *oz.*) diluted with air, at a temperature of 104°—150° F., and applied, by means of a suitable apparatus, for ten minutes to half an hour; every possible precaution being taken to prevent it being inhaled. In chronic liver affections, gradually and cautiously increasing the ingredients to three times the above quantity, and decreasing the dilution with air until the gas is used nearly pure. This is a dangerous remedy in careless or unskilful hands; and even with the experienced not always free from danger. A single inspiration of the gas which has accidentally escaped its proper limits may cause great danger to life.

Bath, Cold. *Syn.* BALNEUM FRIG IDUM (-frĭj′-), FRIGIDA″RIUM, L.; BAIN FROID, Fr. Water, fresh, saline, or mineral, at a temperature varying from 33° to about 75° F.; but usually understood to apply to water between 50° and 70° F. When below 50° F. it is considered very cold. At a temperature ranging from 60° to about 75° F. it is commonly used by the healthy and vigorous as a luxury, and for cleanliness.

The temperature of the water of the rivers and the coasts of England ranges, in summer, from 55°—70° or 72° F.

Bath, Creosote. Creosote, 2 *dr.;* glycerine, 2 *oz.;* boiling water, 1 gall. To be added to 22 galls. of water.

Bath, Douche. See BATH, SHOWER, DOUCHE, &c.

Bath, Dry. *Syn.* BAL′NEUM SICCUM, L. The immersion of the body in any dry material, as ashes, salt, sand, &c. EARTH-BATHING, as administered by the once notorious quack, Dr. Graham, was of this kind. In the sudatorium or sweating-room of the ancients the body was immersed in heated sand.

Bath, Elec′tric. *Syn.* BAL′NEUM ELEC′TRICUM, L. The patient, placed on an insulated stool, is put in contact, by meaas of a metallic wire, with the prime conductor of an electrical machine in action. The surface of the body is thus rendered electro-positive, and the surrounding air, by induction, electro-negative. It has been recommended in chronic rheumatism, scirrhous tumours, &c.

Bath, Electro-chemical (of *Dr Caplin*). This is founded on the supposition that all diseases arise from the presence of mineral, or other extraneous morbific matter, in some organ, or the whole organism, and which is capable of removal by electrolysis. The patient is placed in an appropriately arranged voltaic bath, and there "saturated with the electric fluid." This "decomposes everything which is foreign to the organism, the vital parts being protected by the law of conservation belonging to every organic production." These foreign substances are said to be thus carried out of the system by the electric current, and to be "fixed and plated on the copper in the same way, and according to the same law and principle (only reversed), as in the process of electro-plating" ('Hist. Records of the Electro-chem. Bath,' by Mons. J. F. J. Caplin, M.D., Baillière, 1860).

Bath, Fe′cula. *Syn.* BAL′NEUM AM′YLI, B. FÆC′ULÆ, L. Potato-starch or wheat-starch, 1 to 4 *lbs.;* boiling water q. s. to dissolve. Resembles the BRAN-BATH.

Bath, Ferru′ginous. *Syn.* CHALYB′EATE BATH; BAL′NEUM FERRUGIN′EUM, B. CHALYBEATUM, L. Ferrous sulphate, 1 to 2 *lbs.* A well-tinned copper, wooden, or japanned bath may be used. In general debility when chalybeates are indicated, and the stomach will not bear iron; also in piles and prolapsus. The stains on the towel used to wipe the patient may be removed by at once soaking in water acidulated with hydrochloric acid.

2. (Ioduretted.) See BATH OF IODIDE OF IRON.

Bath, Foot. *Syn.* PEDILU′VIUM, L. Warm (or hot). Revulsive, counter-irritant; in colds, menstrual and hæmorrhoidal suppressions, rheumatism, stiffness of the ankles, tender feet, &c. A little common salt, flour of mustard, or sal-ammoniac, is often added to render it more stimulant, to prevent 'taking cold,' &c. See FEET, &c.

Bath, Gelat'inous. *Syn.* BAL'NEUM GELATINO'SUM, B. GELATIN'II, L. Gelatin or fine Salisbury glue, 3 or 4 *lbs.;* dissolved in boiling water, 2 galls., or q. s.; and added to a warm bath. At the 'Hospital for Cutaneous Diseases' 8 *lbs.* of patent size are used for a bath of 30 to 35 galls. Emollient; formerly, but erroneously, considered nutritive. *Used* in skin diseases; generally combined with sulphur. See BATH, BARÈGES.

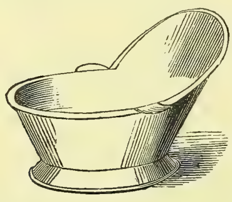
Bath, Gluten. *Syn.* BALNEUM GLUTINIS. Clarified size, 2 lbs.; water, 95°—105° F., 30 galls. (University College Hospital).

Bath, Glyc'erine (glĭs'). *Syn.* BAL'NEUM GLYCERIN'II, B. G. COMPOS'ITUM, L. Glycerine, 2 *lbs.;* gum arabic (dissolved), 1 *lb.* *Used* as a soothing emollient, in itching, dryness, irritation, and hardness of the skin, &c. Where expense is an object, 3 or 4 *lbs.* of good honey, and 1 *oz.* of salt of tartar, form an excellent substitute for the glycerine.

Bath, Hem'lock. *Syn.* BAL'NEUM CO'NII, L. 1. Dried hemlock-leaves (or herb), 4 to 6 handfuls; water, 1 gall.; infuse 2 hours, and strain. The part to be immersed in, or bathed with, the warm infusion, observing not to apply it if the skin is unsound; or it may be added to the water of a bath in the usual manner. This bath is made more active by the addition of washing soda. In gout, cancer, chronic rheumatism, and certain skin diseases.

2. (Cut. Hosp.) Extract of hemlock, 2 *oz.;* starch, 1 *lb.;* boiling water, 1 gall.; dissolve. For a bath of about 30 galls. As the last.

Bath, Hip. *Syn.* COXÆLU'VIUM, L. Usually warm; sometimes fully warm, or somewhat hot. In inflammatory, spasmodic, and chronic affections of the abdominal and pelvic viscera; in suppressed and painful menstruation, hæmorrhoids, strangury, prolapsus, ischuria, &c.; also as a substitute for a full bath, when this last is contra-indicated by some affection of the lungs, heart, brain, or great vessels. Like full baths, it may be often advantageously medicated. See BIDET.



Bath, Hot. *Syn.* BAL'NEUM CAL'IDUM, CALDA''RIUM, L.; BAIN CHAUD, Fr. Usual temperature, 98°—106° F.

The hot bath has a remarkably tranquillising effect upon the nervous system, producing a strong tendency to quietude and sleep. It also acts as a powerful antispasmodic, and by determining the blood to the the surface of the body tends to relieve visceral inflammation and congestion. In chronic affections arising from the action of cold and damp and from exhausted energy, in stiff joints, rheumatism, neuralgia, diarrhœa, convulsions in young children, and numerous other affections, its effects are often rapid and remarkable. At high temperatures it strongly stimulates the arterial system, and arouses nervous energy and vital action, producing excessive excitement and turgescence, followed by copious perspiration, which has been often found successful in cholera, paralysis, &c. If the immersion be too long continued, or the bath be injudiciously employed, lassitude, debility, and somnolency ensue, and the good effect of the bath is more or less lost. In these cases violent throbbing and painful distension of the vessels of the head, with a distressing feeling of suffocation and anxiety, are premonitory symptoms of impending apoplexy—an accident which sometimes, though seldom, follows its improper use.

Bath, Hydrochlo''rate of Ammonia. See BATH, CHLORIDE OF AMMONIUM.

Bath, Hydrochlo''ric Acid. *Syn.* MURIAT'IC ACID BATH; BAL'NEUM HYDROCHLO''RICUM, B. ACIDUM H., B. MURIAT'ICUM, &c., L. Commercial hydrochloric acid, 1 to 3 *lbs.* (in chronic liver affections); or 3 to 6 fl. oz. (in prurigo and lichen).

Bath, Hydrosul'phuretted. *Syn.* BAL'NEUM HYDROSULPHURE'TUM, L.—1. A tepid sulphuretted bath, with the addition of hydrochloric acid, 2 or 3 *fl. dr.*, immediately before immersion. In rheumatism, chronic skin diseases, hooping-cough, and certain forms of paralysis. 2. A tepid bath to which 3 to 6 *fl. oz.* of (liquid) hydrosulphate of ammonium is added immediately before use. Used as the last. It often acts almost as a specific in hooping-cough and certain breath ailments.

Bath, I'odide of I'ron. *Syn.* BAL'NEUM FER'RI IODI'DI, L. *Prep.* (*Pierquin.*) Iodide of iron, ½ *oz.* to 2 *oz.* In amenorrhœa, leucorrhœa, chlorosis, scrofula, &c.; gradually increasing the quantity of the iodide until 4 *oz.*, or more, is used for a bath.

Bath, I'odine. *Syn.* BAL'NEUM IODIN'II, L. —1. Iodine, 3 to 5 *dr.*; dry siliceous sand, 2 *oz.*; triturated together until reduced to fine powder, and then agitated with the water of a tepid bath for 10 or 15 minutes. 2. (Cutan. Hosp.) Iodine, 4 *dr.*; liquor potassæ, 4 *oz.*; water, 2 pints; dissolve; for a bath of 30 galls. In skin diseases complicated with scrofula, glandular enlargements, amenorrhœa, &c.

Bath, Io'duretted. *Syn.* IO'DURATED BATH, I'ODISED B., COMPOUND IODINE-B., &c.; BAL'NEUM IODURE'TUM, B. IODURA'TUM*, B. POTASSII SUPERIODI'DI, &c., L. Lugol, the leading authority on this subject, employs this bath of the different strengths, &c., shown in the following tables.

a. FOR ADULTS:

Degree.	Iodine.	Iodide of Potassium.	Water for the bath.
	dr.	dr.	gal.
1	2 to 2½	4 to 5	50
2	2 „ 3	4 „ 6	60
3	3 „ 3½	6 „ 7	75

b. For Children:

Age.	Iodine.	Iodide of Potassium.	Water.
	gr.	gr.	gal.
4 to 7	30 to 36	60 to 72	9
7 „ 11	48 „ 72	96 „ 144	18
11 „ 14	72 „ 96	144 „ 192	31

*** The dry ingredients of the first table are to be dissolved in a pint of water, and of the second, in ½ pint of water, before adding them to the bath.

In scrofulous affections and the other cases in which the external use of iodine or the iodides is indicated. Enamelled ware, stoneware, or wooden vessels must be employed.

Bath, Lime. *Syn.* Bal'neum cum cal'ce, L. Lime, 3 *lbs.*; slaked, and added to the bath. In gout, lithic diathesis, itch, &c. See Bath, Vapour.

Bath, Mercu''rial. *Syn.* Antisyphilit'ic bath; Bal'neum mercuria'le, B. hydrar'gyri bichlori'di, B. antisyphilit'icum, &c., L.; Bain mercuriel, B. antisyphilitique, &c., Fr. Bichloride of mercury, in fine powder, 1 to 3 *dr.*, hot water, 1 pint; agitate together until solution is complete, before adding them to the bath, the 'water' of which (contained in an enamelled or wooden vessel) must be soft (rain) and pure. At the 'Cutan. Hosp.' hydrochloric acid (= 1-3rd the weight of the chloride) is commonly added; and at the 'Fr. hospitals,' an equal, or rather more than an equal weight, of sal-ammoniac. These additions facilitate the solution of the chloride, and retard its decomposition by any slight impurity in the water forming the bath.

Uses, &c. In syphilitic affections, either with or without skin disease; in chronic rheumatism, swelled joints, and chronic skin diseases generally, where the use of mercury is indicated, and the remedy is rejected by the stomach; especially in these affections in women and children (for the last, proportionately reduced in strength and quantity). Also used in it, and to destroy pediculi on the body.

Bath, Met'al. See Bath (in *chemistry*), Fusible Metal, &c.

Bath, Mud. *Syn.* Bal'neum lu'teum, B. lu'ti, L. Mud-bathing (illuta'tion) was common among the ancients. The slime of rivers, and the mud on the sea-shore, were especially prized for this purpose. The Tartars and Egyptians still employ baths of this description in hypochondriasis, scrofula, and scurvy. At Frazenbad, in Germany, an acidulous species of black bog-earth found there, is beaten up with warm water to a semi-liquid consistence, and used as a bath. This is said to render the skin satin-like and soft; and to be useful in debility, and in paralytic affections of a gouty origin. In France, hot dung (dung bath) is occasionally used in rheumatism; and in Poland, in syphilis. The husk of grapes and the refuse of olives, after undergoing a partial fermentation, have been successfully employed in France against acute rheumatism (Mérat and De Lens, 'Dict. Univ. de Mat. Méd.').

Bath, Muriat'ic. See Bath, Hydrochloric Acid.

Bath, Mus'tard. *Syn.* Bal'neum sina'pis, L. —1. Flour of mustard, 2 *lbs.*; warm water, 1 *gall.*; make a thin soup; in fifteen minutes pour it into a coarse linen bag or cloth, and press out the liquid, which is to be stirred up with the bath. In cholera, diarrhœa simulating cholera, &c.; also to cause reaction; the patient remaining in the bath until a somewhat painful sense of burning and irrtation is experienced. 2. Flour of mustard, 3 to 8 *oz.*; as before. Used as a gentle stimulant to excite the skin, and promote its healthy action, &c.

Bath, Ni'tro-hydrochlo''ric. *Syn.* Ac'id bath‡ (ăs'-), Nitro-muriat'ic b.*, N. a. b.*; Bal'neum nitro-hydrochlo''ricum, B. ac'idi (ăs'-), B. a. nitro-hydrochlo''rici, B. a. nitro-muriat'ici*, &c., L. 1. Water slightly acidulated with the acid, so that its sourness to the taste is about that of common vinegar. According to Ainslie, 1 *oz.* of acid is sufficient for 1 gall. of water (Mat. Med. Indica, ii, 340). Other formulæ in use are—

2. (*Cutan. Hosp.*) Nitric acid, 1½ lbs.; hydrochloric acid, 1 *lb.*; for a bath of 60 to 70 galls.

3. (*Soubeiran.*) Nitro-hydrochloric acid, 4 to 16 fl. oz., according to the case.

4. (*Dr Scott.*) Nitric acid, 2 fl. oz.; hydrochloric acid, 3 fl. oz.; water, 5 fl. oz.; mix. 1½ to 2 *fl. oz.* to each gall. of water for a general bath; 3 *fl. oz.* to the gall. for a foot, knee, or sponge bath.

Uses, &c. In its weaker forms in skin diseases depending on disordered liver; in others, chiefly in liver complaints, and to relieve the pain on the passing of gall-stones. It must be contained in an enamelled or wooden vessel, and may be used as a hip, knee, or foot bath, a knee-bath being the one generally adopted in England. Dr Scott, of Bombay, who first brought this bath into notice, once plunged the Duke of Wellington up to his chin in one in India, and thus cured him of a severe hepatic affection. In its stronger form it causes tingling and pricking of the skin, and a peculiar taste in the mouth, and affects the gums and salivary glands, often producing plentiful ptyalism, without which, indeed, its advocates regard its action as incomplete. Time of application, 15 to 20 minutes daily, for a fortnight or three weeks; and afterwards, every second or third day.

Bath, Oak-bark. *Syn.* Bal'neum quer'cûs, B. quer'ci, L. Oak-bark, 3 or 4 handfuls for a child, 10 to 15 for an adult; made into a decoction, and strained with pressure into the bath. In hæmorrhoids, prolapsus, leucorrhœa, hernia, diarrhœa, ill-conditioned and bleeding ulcerations, &c. Drs Elaesser, Eberle, and Fletcher have successfully employed it in the intermittents of infancy and childhood, tabes mesenterica or scrofula, &c. It has also proved useful in phthisis.

Bath, Oil. *Syn.* Bal'neum oleo'sum, L. Olive or other oil (hot), strongly aromatised with the oils of cassia, cloves, nutmegs, cedron, and juniper; and digested for a week on ambergris

and vanilla, of each (bruised), about 10 gr. to the gall. Used, in the East, to anoint the body, as a preservative against the plague and other contagious diseases; also as a full bath or hip-bath, the immersion being for 15 to 30 minutes.

Bath, Pneumat'ic. See BATH, AIR.

Bath, Saline' (Gelatinous). *Syn.* BAL'NEUM SALI'NO-GELATINO'SUM, L.; BAIN DE PLOMBIÈRES, Fr. *Prep.* Common salt and Flanders glue, of each 2 *lbs.;* water, 1 gall.; dissolve separately, and add the solutions to the bath. In scrofula, &c.

Bath, Salt. See BATH, SALINE; BATH, SEA, &c.

Bath, Sand. *Syn.* BAL'NEUM ARE'NÆ, L.; BAIN DE SABLE, Fr. See BATH (in *chemistry*), BATH, DRY, &c.

Bath, Sea. *Syn.* BAL'NEUM MARI'NUM, L.; BAIN MARIN, Fr. Immersion in the sea or in recent sea water (temperate, tepid, warm, or hot). Owing to the saline matter which it contains, it possesses stimulant, alterative, and resolvent properties, superadded to those of pure water at the corresponding temperature. When taken, in summer, on our coasts, the reaction and glow follow more speedily and certainly than after a common water-bath; and it may be taken with greater safety, and for a longer period. It often proves very serviceable in diseases accompanied with debility, in phthisis, scrofula, glandular enlargement, &c. A warm or hot sea-water bath is one of the most restorative imaginable; often removing the effects of fatigue and exposure—exhaustion, stiff joints, cramps, rheumatism, &c. —like a charm. Unless under sanction of a medical man, boys and girls should never be allowed to bathe in the sea after the end of September. See BATH (*above*), WATERS, &c.

Bath, Sea (Factitious). *Syn.* BAL'NEUM MARI'NUM FACTI''TIUM, L. Artificial sea water, or rather a substitute for sea water, for this purpose, is commonly prepared by adding about 3% of common salt to ordinary water, or (say) for small quantities—1¼ *oz.* to the qt.; 5 *oz.* to the gall.; and for large quantities, as a full bath—2 *lbs.* to every 7 galls. The following are, however, more serviceable imitations:

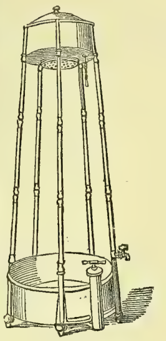
1. As above, with the addition of 1 *dr.* of iodide of potassium to every 3 or 4 galls. of water.

2. (*Cutan. Hosp.*) Common salt, 8 *lbs.;* sulphate of magnesia, 2 *lbs.;* chloride of calcium, 1 lb.; water, 50 to 60 galls.

3. Salt, a handful; water, a pailful; flour of mustard, 1 *oz.* For a foot-bath.

4. Or can be made from true sea salt, an article of commerce.

Bath, Show'er. *Syn.* IMPLU''VIUM, BAL'NEUM PEN'SILE, &c., L.; DOUCHE, Fr. Similar in its effects to the cold bath or plunge-bath, but without many of its advantages. It is less alarming to nervous persons, and less liable to produce cramp than immersion in cold water; whilst the reaction or glow follows more speedily and certainly. It is considered the best and safest mode of cold bathing, and is often highly serviceable in nervous affections. A good plan is to allow the water to remain in the bedroom all night, by which any undue degree of coldness is removed. Tepid water may be commenced with; and at first, in extreme cases, the patient may stand in hot or warm water at the time of taking the bath. The reaction following its use is greatly promoted by friction of the surface with dry rough towels.



Bath, Soap. *Syn.* BAL'NEUM SAPO'NIS, L. White soap, 2 to 3 *lbs.;* water, 3 qts.; dissolve by heat, and add it to a warm bath. Detergent, lubricating, and discutient; in itch and other skin diseases, &c.

Bath, Spon''ging (spŭnje'-). This title explains itself. In the sponging bath exercise and ablution are combined, and its employment by persons of sedentary habit is highly advantageous.

Bath, Sulphur. *Syn.* BAL'NEUM SUL'PHURIS, L. 1. Flowers of sulphur, ½ to 1 *lb.;* water, a pailful; mix, agitate occasionally for 12 to 24 hours, and then add the whole to an ordinary bath. Useful in various mild but obstinate skin diseases. Its occasional employment, even in health, seldom fails to render the skin soft, smooth, and delicate. Soap may be used with it.

2. (Compound; B. S. COMPOS'ITUM, L.) (*a*) (*Cutan. Hosp.*) Precipitated sulphur, 2 *lbs.;* hyposulphite of soda, ½ *lb.;* water, 1 gall.; dissolve, and add of sulphuric acid, 1 *dr.* One pint to every 30 galls. of water. In various skin diseases (see *below*).

(*b*) See BATH, SULPHURETTED.

Bath, Sul'phurous. *Syn.* SUL'PHUROUS ACID BATH; BAL'NEUM SULPHURO'SUM, B. SUL'PHURIS‡, L. From sulphur, ½ *oz.*, sprinkled on a hot plate placed under or near the patient; the proper precautions being taken as directed under CHLORINE BATH. In itch, lepra, psoriasis, &c. Cleanly, but seldom used, chiefly on account of the number of baths required to prove serviceable. See BATH, SULPHURETTED.

Bath, Sul'phuretted. *Syn.* BAL'NEUM SULPHURE'TUM, B. SULPHURA'TUM, B. SULPHU''REUM, &c., L.; BAIN SULFURÉ, &c., Fr. 1. Sulphurated potash, 1 *oz.* for every 10 or 12 galls. of water employed. Sometimes sulphurated soda, or (in the Ger. Hosp.) sulphurated lime, is the sulphur-salt employed. ½ *dr.* of sulphuric acid is also occasionally added to the bath; but this increases its fœtor, without adding much if anything to its curative power; whilst, without care, the evolved gas may impede respiration.

2. (Gelatinous; GELAT''INO-SUL'PHUROUS B.; B. S. GELATINO'SUM, L.) Flanders glue, 1½ to 2 *lbs.;* dissolved and added to a 'sulphuretted bath.' Recommended, by Dupuytren, as a substitute for the 'Barèges bath.'

Obs. The sulphur or sulphuretted bath, under any of its forms, is a powerful remedy in almost every description of skin disease. Leprosy, the most obstinate of all, has been completely cured by it; the common itch requires only one or two applications to eradicate it entirely; all the scurfy and moist skin affections, local irritation,

pimples, inflammatory patches, &c., speedily yield to its influence; scrofula, and, indeed, *all* those affections in which the warm or vapour bath is serviceable, also derive powerful assistance from the sulphur bath.

Bath, Tem'perate. *Syn.* BAL'NEUM TEMPERA'TUS*, L.

Bath, Tep'id. *Syn.* BAL'NEUM TEP'IDUM, B. EGEL'IDUM, TEPIDA''RIUM, L.; BAIN TIÈDE, &c., Fr. Approaches the warm bath in its hygienic and medical properties, and is, perhaps, the one best adapted for the mere purposes of personal cleanliness. In the spacious public tepid baths of London, swimming may be safely indulged in even in cold weather.

Bath, Tum'ble. An obsolete form of the shower bath.

Bath, Turk'ish. *Syn.* BAL'NEUM TUR'CICUM, L. A hot vapour-bath or sweating bath, with massing or shampooing, ending with a warm bath or warm ablutions and friction. The EGYPTIAN, PERSIAN, and RUSSIAN BATHS are essentially similar. In the ANGLO-TURKISH BATH, recently introduced to this country, hot dry air wholly takes the place of vapour. See BATH, AIR (*antè*).

Bath, Turpentine. *Syn.* BAL'NEUM TEREBINTHINA'TUM, L. *Prep.* (*Dr T. Smith*). Camphine (rectified oil of turpentine), $\frac{1}{4}$ to $\frac{1}{2}$ pint; Scotch soda, 2 lbs.; oil of rosemary, $\frac{1}{2}$ dr.; for an adult. It calms the pulse, softens the skin, and renders the perspiration freer.

Bath, Va'pour. *Syn.* DEW'-BATH*; BAL'NEUM VA'PORIS, B. RO''RIS†, AS'SA SUDA'TIO, A. VAPORA'TIO, VAPORA''RIUM*, L.; BAIN DE VAPEURS, Fr. The vapour of hot water, either pure or medicated.

The following are the temperatures, &c., of this bath:

	Temperature of Vapour, Fahr.	
	Breathed.	Not breathed.
Tepid vapour bath	90° to 100°	96° to 106°
Warm „ „	100 „ 110	106 „ 120
Hot „ „	110 „ 130	120 „ 160

Uses, &c. It is one of the most powerful diaphoretics known, and is almost specific in nearly all those cases wherein warm or hot bathing proves advantageous. It is one of the most certain agents existing in cases of chronic rheumatism, contracted muscles and tendons, stiffness of joints, indurations, dysentery, diarrhœa, suppressions, &c. Instances are numerous in which the lame have thrown aside their crutches and the bedridden have again mixed with the world after a few applications of this bath. It is no uncommon thing to hear a patient start and shriek with agony before entering the bath, and to receive his congratulations and thanks on his coming out. They often exclaim—"It is wonderful; I could not have believed it!"

Bath, Warm. *Syn.* BAL'NEUM CAL'IDUM, B. CALID'ULUM, B. THERMA'LE, THERM'A, &c., L.; BAIN THERMAL, B. CHAUD, &c., Fr. A bath at a temperature equal, or nearly equal, to that of the human body.

As a remedial agent, the warm bath is adapted to general torpor of the system, liver and bowel complaints, hypochondriasis, hysterical affections, morbid suppressions, dryness of the skin, nearly all cutaneous and nervous diseases, chronic rheumatism, &c. As a tonic or stimulant after excessive fatigue, great mental excitement, or physical exertion, it is unequalled, and furnishes one of the most wholesome, and at the same time luxurious sources of refreshment we are acquainted with. "To those who are past the meridian of life, who have dry skins and begin to be emaciated, the warm bath for half an hour, twice a week, I believe to be eminently serviceable in retarding the advances of age" (*Darwin*). The healthy longevity of the late Duke of Wellington, after a period of exposure and trials equal to the entire life of many individuals, has been by some, and we think correctly, mainly attributed to the free and constant use of the warm bath. A warm bath frequently gives great relief to infants suffering from griping or flatulence. See BATH (*antè*), &c.

Bath, Wa'ter. *Syn.* BAL'NEUM A'QUÆ, B. AQUO'SUM, B. MA''RIÆ, B. MA''RIS, L.; BAINMARIE, Fr. A water-bath; in *chemistry* and *cookery*, applied to a bath of hot or boiling water. See BATH (in *chemistry*), BAINMARIE, &c.

BATH'ING (bāthe-). See BATH.

BATH METAL. A species of brass having the following composition:—

1. Zinc, 3 parts; copper, 16 parts; melted together under charcoal.

2. Fine brass, 32 parts; spelter, 9 parts. See BRASS and ALLOYS.

BATH PIPE. See PIPES.

BATH, VICHY (ARTIFICIAL). Bicarbonate of sodium, 17 *oz.*; water, 60 *galls.*

BATHS and WASH'HOUSES. See BATH.

Baths, Sensitising. See PHOTOGRAPHY.

BATTER. Ingredients beaten together so as to form a semi-fluid mass. In *cookery*, a semi-fluid paste, which becomes hard in dressing, formed of flour, and milk or water, or a mixture of them, enriched and flavoured with eggs, butter, and (frequently) spices, currants, &c., at will. Used for frying vegetables, fillets, &c., and as a material for fritters and pancakes; also to form puddings, which are either baked alone, or under meat; and to cover various articles during the operation of cooking them. Miss Acton gives the following formulæ:—1. (For the Frying-pan.) Butter, 2 *oz.*; boiling water (nearly), $\frac{1}{4}$ pint; mix, and stir in, gradually, of cold water, $\frac{3}{4}$ pint; when quite smooth, mix it by degrees, very smoothly with fine dry flour, $\frac{3}{4}$ *lb.*; adding (for fruit) a small pinch of salt (but more for meat or vegetables); just before use, stir in the whites of two eggs (or the white and yelk of one), and fry until light and crisp. In humble cookery the eggs may be omitted.

2. (For Puddings.) Eggs (yelk and white, about 4 in number; flour, $\frac{1}{2}$ *lb.*; milk, a sufficiency.

Obs. When fruit, &c., are added, the batter must be made thicker than when none is used, to prevent it sinking. When sufficiently dressed it should cut smoothly and not stick to the knife. Eggs increase its firmness.

BATT'ERY. The word battery, as applied to electrical apparatus, belongs strictly to a collection of Leyden jars charged with static electricity. These discharge their store of force in a violent manner, totally unlike the equable flow of current obtained from collections of voltaic or galvanic cells. French electricians speak and write of such generators under the name of 'Piles,' doubtless in deference to the form of the first voltaic generator of electricity made—the pile of metal discs invented by Volta. English electricians apply the word battery to all apparatus in which electricity is generated by chemical decomposition, and also to those forms of storage cells known as accumulators and Leyden jars. See ELECTRO-PLATING.

BAUME (Baumé). See AREOMETER.

Baume, Nerval. See OINTMENTS.

BAUXITE. A ferruginous aluminic hydrate containing 55·4% of alumina and 44·5% of ferric oxide. It is met with in roundish masses in the crystalline limestone of Baux (hence its name), near Arles, in France. Bauxite is one of the sources of alum.

BAY ESSENCE. BAY RUM. This compound, which is largely employed as a perfume in America, and is one of the articles of the United States' Pharmacopœia, is, when genuine, imported from the West Indies, where it is said to be prepared by distilling rum, with the leaves of the bayberry tree or wax myrtle, *Myrica cerifera.* More than three fourths, however, of the bay rum consumed is undoubtedly an imitation of the imported essence, and is a mechanical mixture of the volatile oil of the bayberry tree, rum, and spirit; sometimes with the addition of aromatic spices and various colouring matters. The volatile oil from which this last preparation is made is frequently adulterated to a large extent.

Mr Rother, an American chemist, states that in one sample alone he found about 50% of fixed oil. The imported rum is far superior in point of fragrance to the artificial. When mixed with water the genuine essence remains clear, whilst the imitation almost always becomes turbid or milky.

Mr Rother finds the following formula to yield a satisfactory product, and one much stronger in aroma than the imported perfume:

Oil of bayberry	1 fl. oz. and ♏ xx.	
Jamaica rum	1 pint	o.m.
Strong alcohol	4 pints	
Water	3 „	

Mix the rum, alcohol, and water, then add the oil; mix, and filter.

Bay Rum. One of the highly valued American head-washes, pleasant in use, cooling and cleansing, and promoting the growth of the hair. It is prepared by distilling rum from the leaves of *Myrica acris* (called 'Bayberry' in America).

Bay, Sweet. LAURUS NOBILIS, L. The classic Victor's Laurel, sacred to Apollo. A South European shrub. The aromatic leaves are employed in cookery. From the berries a green odorous oil is obtained, sometimes used in perfumery. See MYRICÆ.

BDEL'LIUM (dĕl'-yŭm). The commercial name of two gum-resins:

Bdellium, Af'rican. *Syn.* BDELLIUM AFRICA'NUM, L. From *B. africanum,* Arn; BESABOL from *B. Kataf,* Kth.; and HODTHAI from *B. Playfairii,* Hook f.

Bdellium, In'dian. *Syn.* IN'DIAN MYRRH, FALSE M.; BDELLIUM (of Scripture); BDELLIUM IN'DICUM, L. From *Am'yris commĭph'ora,* Roxb., or *Balsamoden'dron Roxbur'gii,* and *B. mukul,* Hook., a terebinthaceous tree of India.

Prop., &c. Once considered slightly deobstruent; sometimes used as a pectoral and emmenagogue, and, externally, as a stimulant and suppurative. It is now seldom met with in this country.

Further light is much needed upon the true sources of these resins; and specimens of the shrubs (in flower or fruit) which furnish them, accompanied by a sample of the product, would be very valuable, if sent by those who have the opportunity of proving them to the curators of botanical collections such as Kew, &c.

BDELLOM'ETER (dĕl-). *Syn.* MECHAN'ICAL LEECH; BDELLOM'ETRUM, L.; BDELLOMÈTRE, Fr. In *surgery,* a contrivance combining the principle of the cupping-glass, scarificator, and exhausting-syringe in one small instrument.

BEACH'S (Dr) Specific against Hemorrhoids and Stomach Complaints of all Kinds. A tin box containing about 160 grms. of a fine sulphur-yellow powder, and imbedded in it a vial with 40 grms. of a brown clear fluid. The powder is a mixture of 7 parts of washed flowers of sulphur, 2½ parts cream of tartar, 1-6 part of an inferior kind of rhubarb, finely powdered. The drops consist of a solution of brown sugar in strong spirit, with traces of various ethers (*Hager*).

BEAD (bēde). *Syn.* GLOB'ULUS, SPHÆR'ULA, &c., L.; GRAIN (de collier), &c., Fr.; BETHE, PERLE, &c., Ger. A little ball or spheroid pierced for stringing; any very small globular body‡; a bubble (‡ or tech.). A number of the first mounted on a thread or ribbon form a 'string of beads' or 'chaplet.'

Materials, Manufac., &c. Beads are often formed of coral, gems, jet, pearls, porcelain, rock-crystal, &c.; but much more frequently of white and coloured glass. The mode in which these last are produced is as follows:—Glass tubes, appropriately ornamented by colour, reticulation, &c., are drawn out in various sizes, and from 100 to 200 feet in length. These tubes are cut into 2-feet lengths, and then, by means of a steel knife, divided into pieces having, as nearly as possible, the same length as diameter. The resulting small fragments or cylinders are next well stirred with a mixture of sand and wood ashes, in order to prevent the closure of the perforations and their adhering together during the subsequent part of the process. They are then placed in a revolving cylinder and gradually heated until they become sufficiently spherical. They are next sifted from the sand and ashes, sorted into sizes, first by means of sieves, and afterwards by hand, and are lastly either put up in weighed parcels or strung by women and children for the market.

The manufacture of coral, gems, jet, and minerals generally, into beads, belongs to the lapidary.

Uses. Chiefly to form necklaces, bracelets, and

other articles of personal ornament; by milliners to decorate head-dresses, &c.; and for other like purposes. They are also employed among Catholic and Mohammedan nations for devotional purposes; and among savage tribes in lieu of money. They are still sometimes worn as amulets. See BUGLE, CORAL, GLASS, PASTE, PEARLS, &c.

Beads, Jum'ble (bēdz). The dried seeds of *A'brus precator'ius*, Linn., or Jamaica wild liquorice. Hard and indigestible; accounted cephalic and ophthalmic by the vulgar. See ABRUS.

Beads, Lo'vi's. *Syn.* SPECIF'IC-GRAV'ITY BEADS. Small hollow spheres of glass carefully adjusted and numbered, in sets, intended to supersede the hydrometer in determining the density of fluids. They are used by dropping them into the liquid, in succession, until one is found that exhibits indifference as to buoyancy, and will float under the surface at any point at which it may be placed. The number on this ball indicates, in thousandths, the sp. gr. sought. They are particularly serviceable in the hurry of the commercial laboratory, and have the advantage of being applicable to very small quantities of liquid; but their use, of course, requires the same precautions, and the results obtained the same corrections for deviations from the normal temperature, as with other instruments. See HYDROMETER, SPECIFIC GRAVITY, &c.

Bead. *Syn.* BEAD'ING‡. In *architecture, cabinet-work*, &c., any small moulding or continued projection of which the vertical section is semicircular.

Bead (of Liquors). [Tech.] The small bright iridescent bubbles, possessing some slight degree of permanence, which form on the surface of alcoholic liquors of sufficient strength, when agitated. See ALCOHOLOMETRY, PROOF, &c. (also *below*).

BEAD'ING. In the *liquor trade*, anything added to commercial spirits to cause them to carry a 'bead' and to hang in pearly drops about the sides of the glass or bottle when poured out or shaken. The popular notion being that spirit is strong in proportion as it 'beads,' the contrary is, however, the case; the object is to impart this property to weak spirit, so that it may appear to the eye to be of the proper strength. Various formulæ are current among the 'knowing ones' of the trade, most of which are unscientific, and many of them absolutely ineffective. The following are those now usually employed:

Prep. 1. Oil of sweet almonds and oil of vitriol, of each 1 *oz.;* rub them together in a glass, porcelain, or wedgewood-ware mortar or basin, adding, by degrees, of crushed lump-sugar, 1 *oz.;* continue the trituration until the mixture becomes pasty, then add, gradually, sufficient rectified spirit (strongest) to render the whole perfectly liquid; pour it into a quart bottle, and wash out the mortar twice, or oftener, with a little fresh spirit, until about 1 pint of rectified spirit has been employed, adding the washings each time to the bottle; lastly, cautiously shake the bottle (loosely corked) until admixture appears complete, and then set it aside in a cool place. For use this compound (after agitation) is thrown into a two-gallon can or measure, which is then filled, from a tap, with the spirit to be 'beaded,' when the whole is thrown into the cask, and the measure washed out by refilling it and returning it two or three times; after which the contents of the cask are well 'rummaged up.' Gin is usually 'fined' a few hours afterwards; but it is better not to add the 'finings' for two or three days, Other spirits are allowed to become 'fine' by simple repose. According to Mr Hartley and others, this quantity is "sufficient for 100 galls. of any spirit;" but it is more commonly used for a puncheon of 80 to 85 galls.

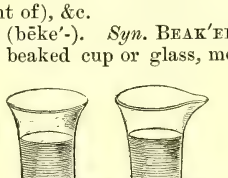
2. Oil of vitriol, 2 to 3 *oz.;* rectified spirit (strongest), 1 pint; cautiously agitate them together in a loosely corked quart bottle; in two or three hours add another pint of rectified spirit, and again agitate. It will be fit for use in a week; as before.

3. Sulphuric ether, ½ *lb.;* strongest rectified spirit, 1 quart; mix. May be used at once, as before; but if otherwise, should be kept, like the last, closely corked and in a cool place.

4. Soapwort root (*Saponaria officinalis*), bruised or rasped small, 1 *lb.;* rectified spirit and water, of each ½ gall.; macerate in a corked jar, with occasional agitation, for eight or ten days, strain with pressure, and, after a few days' repose, decant the clear portion. Used as before.

Obs. The above are not injurious when employed for 'beading,' since the quantity employed is much too small to injure the wholesomeness of the liquor. The fraud consists in their being used to disguise the presence of 10% to 12% of water, which is thus sold at the price of spirit. Beyond a certain degree of dilution they fail, however, to produce the intended effect, the bubbles becoming 'soapy,' and without the requisite permanence. The addition of a little powdered white sugar (½ *oz.* to 1½ *oz.* per gall.) increases the efficacy of all of them. This may be dissolved in the water, if any is added at the time; but its effect on the hydrometer must be recollected. See ALCOHOLOMETRY, GIN, SPIRIT (Management of), &c.

BEAK'ER (bēke'-). *Syn.* BEAK'ER-GLASS. In *chemistry*, a beaked cup or glass, more or less of



the tumbler-pattern, used to collect precipitates and to heat liquids in.

BEAL* (bēle). *Syn.* BOUTON, PUSTULE, Fr. A pimple or pustule; a small inflamed tumour.

BEAM (bēme). See BALANCE, SCALES, &c.

BEAM'-TREE. *Syn.* WHITE BEAM-TREE. The *Pyrus aria*, or wild pear. Wood hard, compact, and tough; used for axle-trees, naves and cogs of wheels, &c.

BEAN (bēne). [Sax., Eng.] *Syn.* FA'BA, L.; FÈVE, Fr.; BOHNE, Ger. The general name of leguminous seeds, as also of the plants which produce them; appr., *Fa'ba vulgār'is*, Mönch. (var. *β*, HORSE'-BEAN, *F. equi'na, F. mi'nor*, &c., L.; *Vi'cia faba*, Linn.), or common GAR'DEN

BEAN; *Phase'olus multiflor'us*, Willd., or SCARLET RUN'NER (var. *a*, *Phase'olus coccin'eus*, red-flowered; *β*, *P. albiflor'us*, white-flowered); and *P. vulgaris*, Sav., FRENCH BEAN, KID'NEY B., or HAR'ICOT (-ko) (var. *a*, *P. unic'olor*, seeds of one colour; *β*, *P. fascia'tus*, seeds striped, or ZE'BRA-STRIPED BEAN; *γ*, *P. variega'tus*, or SPECK'LED BEAN; *δ*, *P. na'nus*, or DWARF BEAN), with their varieties, all of which are annuals cultivated in our gardens—the first chiefly for its seeds, the others both for their green pods and ripe seed. The name is often popularly applied, as an appellative, to the fruit or seeds of other plants which, in size and appearance, resemble common beans, as noticed below. The bean is a native of Persia and the borders of the Caspian Sea, now extensively cultivated over the globe. Large quantities of the seeds, both of home growth and imported from Egypt, are used in this country for feeding horses.

Those principally cultivated in our gardens are the small LIS'BON, SAND'WICH, SPAN'ISH, TOKAY', WIND'SOR, and MAZ'AGAN (from North Africa), with almost innumerable sub-varieties of each. Preparations including the fragrant principle of the flowers are highly prized in modern perfumery.

Qual., &c. The pods eaten in the green state, properly dressed, are regarded as antiscorbutic and wholesome, but are apt to produce flatulence unless combined with spices. In the dried or ripe state they are rather difficult of digestion, and very apt to distend the stomach and intestines with wind. This objection does not exist, to the same extent, to their use in the form of flour or meal. The amount of nutritious nitrogenous matter in beans rather exceeds that in wheat, and independently of a disposition to produce constipation in some habits, and being rather less easy of digestion, they must be considered nearly as wholesome as that cereal. Bean flour has been used to adulterate wheaten flour.

This sophistication may be detected by the appearance it presents under the microscope. The meshes of cellulin are very much larger than those of the fourth coat of wheat, with which it has been sometimes confounded, and the starch grains present a totally different appearance. They are oval or reniform, or with one end slightly larger; they have no well-defined hilum or rings, but many have a deep central longitudinal cleft running in the longer axis, and occupying two thirds or three fourths the length, but never reaching completely to the end; this cleft is sometimes a line, sometimes a chasm, and occasionally secondary clefts abut upon it at parts of its course; sometimes, instead of a cleft, there is an irregular-shaped depression. If a little liquor potassæ be added the cellulin is seen more clearly. If the flour be added to a little boiling water, the smell of bean becomes evident.

Green beans (pods or legumes) are cooked by simply throwing them into boiling water and simmering them until quite tender, taking the precaution of removing the lid of the saucepan, a 'pinch' of salt of tartar, or a little common salt, being usually added to preserve their green colour. Young and small ones take from 12 to 18 minutes—large or older ones longer. The first are merely 'topped and tailed' with a knife before being dressed; the others require also the

'side strings' to be drawn off, and to be cut obliquely into pieces of a lozenge form, or else to be split lengthwise into strips, and then divided once across. Old ones never boil tender. Windsor beans, and other 'shelled beans,' take 15 to 30 minutes according to age. These last are sometimes skinned after being dressed. All of them are commonly 'served up,' or eaten, with melted butter. Beans, although rich in nitrogenous, are deficient in carbonaceous constituents; hence it is curious to note how almost invariably they are when eaten combined with some substance rich in carbon. The Hindoo, for instance, mixes lentils with rice and ghee or a form of clarified butter. In Yucatan and throughout the whole of Central Africa, where a black bean is extensively used as food, they are well boiled in water, and eaten with pepper, salt, and pork. In this country, beans and bacon always appear at table together, and have done so for centuries. See LEGUMINOSÆ, PULSE, &c. (also *below*).

Bean, Algaro'ba. See ALGAROBA.

Bean, Bay, of Bermuda. *Canavalia obtusifolia*, DC. A common shore plant in nearly all warm countries. The seeds germinate after long immersion in sea water; and *C. ensiformis*, DC., the former with bright red, and the latter with marbled or mottled seeds, and scimitar-shaped pods. The young pods of the latter species are eaten in Indian.

Bean, Earth. American earth-nut.

Bean, French; Horse-bean; Kidney bean; &c. See BEAN (*antè*).

Composition (*Einhof*):

	Kidney beans.	Field beans.
Water	23·0	15·6
Albumenoid bodies	23·6	11·7
Starch, sugar, gum, &c.	44·7	58·3
Oil and fat	0·7	2·0
Husk	7·0	10·0
Salts (ash)	1·0	4·4
	100·	100·

Bean, St Ignatius's. The poisonous seed of the fruit of *Igna'tia amār'a,* Linn. (*Strych'nos Igna'tii,* Berg.), a tree indigenous to the Philippine Islands.—*Prop., Uses, &c.* Similar to those of nux vomica. Contains strychnine (which *see*).

Beans, Ordeal, of Old Calabar, West Africa. The seeds of *Physostigma venenosum,* Balf., a large perennial climber found only near the mouth of the Niger and Old Calabar, West Tropical Africa. In these localities it was at one time rare in consequence of the plants being destroyed by order of the native chiefs, except a few which were retained for the use of the seeds as an ordeal. They are imported into this country from Western Africa for medicinal purposes, being used in ophthalmic diseases, tetanus, epilepsy, and other nervous affections. See PHYSOSTIGMINE.

Bean, Sea-. *Entada scandens,* Bth. A large woody climber, widely distributed in the tropics. Some of the legumes measure 4 feet in length by 4 or 5 inches in breadth. The seeds are about 2 inches across, dark brown, hard and shining, and are often made into spoons or small boxes, and are used for crimping linen. They are also eaten by natives in North Queensland after baking, pounding, and steeping for 12 hours in a dilly bag. These seeds are frequently washed up on distant shores from the place of growth; specimens have been so washed up on the coasts of Western Europe and Africa from the tropics to the North Cape.

Bean, Sugar or **Lima** (*Phaseolus lunatus,* L.), from Jamaica. There are two varieties, one with white, the other with purple variegated seeds; the latter are esteemed poisonous in Mauritius owing to their producing, like bitter almonds, prussic acid when macerated in water. This would be dissipated in cooking, and they would then be wholesome.

Beans, Tonquin (*Dipteryx odorata,* Willd.), from Guiana. They are very fragrant, and are used in perfumery, and for scenting snuff. The tree grows to a great size and produces a hard wood. The fruits and seeds of *D. oleifera,* Bth., known as the EBOE tree of the Mosquito shore, are very similar to those of *D. odorata,* but are entirely devoid of fragrance. A large quantity of fatty oil is obtained from the seeds, used by the natives as a hair oil. An odorous crystalline body is present known as *Coumarin.*

BEAR (bare). *Syn.* UR'SUS, L.; OURS, Fr.; BÄR, Ger.; BERA, Sax. In *zoology,* a Cuvierian genus of the 'plantigrade carnivora,' of several species, found both in the Old and New World. Those generally known under the name are omnivorous or frugivorous. The skin of the American black bear (*Ursus America'nus,* Pallas) was formerly highly prized, and fetched an extravagant price. The brown bear (*U. arc'tos,* Linn.) supplies the Kamschatkans, and some other northern races, with many of the necessaries and even the comforts of life. The fat or grease (BEAR'S GREASE; AD'EPS UR'SI, L.) of all the common species has long been highly esteemed for promoting the growth of the human hair; but apparently without sufficient reason. The mass of that sold under the name in England is simply hog's lard or veal fat, or a mixture of them, variously scented and slightly coloured. The quantity annually consumed in Great Britain, and exported, is estimated at many tons; being a larger quantity than all the bears at present procurable in Europe would supply if slaughtered and stripped of their fat.

BEAR'BERRY, Bear's Bil'berry, &c. See UVA URSI.

BEAR'S GREASE. See BEAR (*above*), HAIR COSMETICS, MARROW, POMADES, &c.

BEARD (bēerd). [Sax., Eng.] *Syn.* BAR'BA, L,; BARBE, Fr.; BART, Ger., Dan.; BAARD, Dut. The hair of the lips and chin; but appr., only the last—that on each lip being distinguished, in toilet nomenclature, by a separate name. In popular *botany* and *zoology,* any beard-like appendage; the 'awn' of corn or grass; the 'gills' or breathing organs of oysters and other bivalves, &c.

Beard Tincture, American (Teinture americaine pour la barbe), for dyeing the beard black. Three fluids. No. 1, nitrate of silver solution; No. 2, tincture of galls; No. 3, sodium sulphide solution.

BEARD'ED. *Syn.* BARBA'TUS, L.; BARBU, Fr.; BARTIG, Ger. In *anatomy, botany,* and *zoology,* having a beard, or a beard-like appendage; prickly, barbed, jagged; awned.

BEA'VER (bē'-). *Syn.* CAS'TOR, L.; CASTOR, BIÈVRE, Fr.; BIBER, Ger. The *Fi'ber cas'tor,* Linn., an animal belonging to the RODENTIA of Cuvier, and remarkable for the great ingenuity which it exercises in the construction of its lodges or habitations.—*Hab.* Europe and America. Those of the former are burrowers; those of the latter, builders. The fur has long been employed in the manufacture of the best quality of hats (BEAVER HATS). The fat was officinal in the Ph. L. 1618. Castor (CASTO''REUM) is obtained from this animal.

BE'BERINE (bēbe'-rin‡). $C_{19}H_{21}NO_3$. [Eng., Fr.] *Syn.* BI'BIRINE (bē'bĕr-ĭn); BEBERI'NA, BIBIRI'NA, &c., L. A peculiar alkaloid, discovered by Dr Rodie, in the bark and seeds of the beberu, bibiri, or green-heart tree (*Nectan'dra Rodiæ'i,* Schomb.), of British Guiana; and since minutely examined by Maclagan and Tilley, by Von Planta, and by Dott.

Prep. 1. That of commerce is generally first obtained in the form of sulphate, by a process analogous to that employed in the preparation of sulphate of quinine; and from this salt it is precipitated by the addition of ammonia or an alkali.

2. (Pure.) By precipitating the sulphate with ammonia, washing the precipitate with very cold water, and triturating it, whilst still moist, with fresh hydrated oxide of lead; next drying the mixture by a gentle heat, exhausting the residuum with alcohol, distilling off the alcohol, and treating the last residuum with ether; the ethereal solution on evaporation leaves beberine, under the form of a white or yellowish-white, resinous-looking substance, which is pure white when powdered. It is considered to be a mixture of beberine and nectandrine.

Prop., &c. Amorphous; uncrystallisable; non-volatile; bitter-tasted; inodorous; unalterable in the air; very slightly soluble in water; very soluble in alcohol; less so in ether; reaction alka-

line; when quite pure, melts at 355° F., and on cooling forms a vitreous or semi-vitreous mass (*Winckler*); at a higher temperature it suffers decomposition; ignited on platinum-foil, it burns without leaving any carbonaceous residue; neutralises acids forming salts, most of which are soluble in water.—*Prod.* From the bark, 1·5% to 1·75%; dried seed, 2·5% (nearly).

D. B. Dott obtained hydrochloride of beberine in a pure crystalline form; by adding ammonia to this salt pure beberine was precipitated. Thus obtained, beberine is a white amorphous substance, which loses water by exposure to the heat of a water-bath. The hydrochloride crystallises in small four-sided prisms, and if the solution is neutral is apt to assume the form of a transparent jelly. Beberine forms a deep-red solution with strong nitric acid, which on dilution with water gives a bulky precipitate.

Use, &c. Beberu-bark has been proposed and occasionally employed as a substitute for cinchona bark, and beberine for quinine, in the usual cases; but whether as a tonic, febrifuge, or antiperiodic, they appear less powerful and certain than these last.—*Dose,* 2 to 12 gr. or more. (See *below.*)

Sul′phates of Beberine. Of these there are two, both of which are obtained in a similar manner to the sulphates of quinine, and merely differ in the amount of acid finally left in combination with the alkali:

1. **Sulphate.** *Syn.* NEU′TRAL SULPHATE OF BEBERINE; BIBIRI′NÆ SUL′PHAS, &c., L. Easily soluble in water. Contains 86·4% of beberine, and 13·6% of sulphuric acid.

2. **Subsul′phate.** *Syn.* BAS′IC SULPHATE OF BEBERINE, DISUL′PHATE OF B.; BIBERI′NÆ SUBSUL′PHAS, &c., L. Soluble in alcohol; sparingly soluble in water unless acidulated. Contains 90·8% of beberine, and 9·2% of sulphuric acid, This is the sulphate of beberine of commerce, and the one usually employed in medicine. It is generally met with in thin brownish-yellow scales, which are formed in a similar manner to those of ammonio-citrate of iron.—*Dose.* As a tonic, 1 gr. to 3 gr.; as a febrifuge or antiperiodic, 5 gr. to 20 gr.; in similar cases to those in which disulphate of quinine is employed.

BECH′AMEL (bĕsh′-ă-mĕl‡). *Syn.* BÉCHAMEL, Fr. In *French cookery,* a fine white sauce, essentially consisting of concentrated veal gravy or veal consommé and cream, with or without flavouring. See SAUCES.

BE′CHIC* (kĭk). *Syn.* BE′CHOUS†; BE′CHICUS (bĕk′-‡), L.; BÉCHIQUE, Fr.; HUSTEND, &c., Ger. In *medicine,* &c., of or for a cough; pectoral; also subst., applied to remedies (BE′CHICS; BE′CHICA, L.), used to relieve cough.

BED. [Eng., D., Sax.] *Syn.* LIT, COUCHE, Fr,; BETT, &c., Ger.; CUBI′LE, LEC′TUS, LEC′TULUS, GRABA′TUS, &c., L.; LETTO, Ital. A couch; that in or on which we sleep; that on which anything is generated, deposited or rests.

The term bed is somewhat loosely used to signify a *bedstead* with bedding and coverings complete or only the case filled with soft material, feathers, hair, wool, &c., which forms its basis. In vulgar parlance the term bed so applied indicates a simple bag filled with these materials, and not sewn through as in the case of a mattress or palliasse.

Materials for Beds, Mattresses, &c. Choice of material for this purpose is very important, and demands much more care and attention than is usually bestowed upon it. The feathers, hair, wool, straw, flocks, or whatever be used for filling the case, should be scrupulously clean and free from all foreign and offensive matter, and great care should be exercised in the purchase of it, so as to secure that it shall not be old material fouled and possibly infectious, or even containing vermin. Feather beds are more or less objectionable; they are too soft, and the body by sinking down into them is deprived of necessary ventilation. They are useful for aged and infirm people, but should not be used for the young and healthy, for whom a simple straw or hair mattress is much more suitable; these are said by some to be hard and uncomfortable, but this is very largely a question of habit.

Bed curtains and valances are both unnecessary and objectionable as bed appendages; they collect dirt, dust, and possibly vermin, and as such should be discarded. Before making the bed in the morning the blankets and sheets should be stripped off and allowed to remain for an hour or two in a current of air, on the back of a chair, or some other convenient support. If it does not rain, or is not too damp, they are best placed near the open window. The night-dress which has been slept in should be exposed in the same manner; and on going to bed it would be found a good plan, when removing the inner vest which has been worn during the day, to turn it inside out, and to hang it over the footboard of the bed. Under ordinary conditions the sheets should be changed every week. When it is remembered that on an average a third of a human being's existence may be said to be passed in bed, the importance of his dormitory being kept scrupulously clean will be self evident. Every bedroom should therefore be well swept out each day, and the floor diligently scrubbed once a week. With the exception of a small strip beside the bed, the room should contain no carpet; a piece of New Zealand matting, being less able to retain dust, is preferable to carpeting. It is an excellent plan to stain and varnish the floors. The door and windows of the bed-chamber should be kept more or less open during the day, so as to ensure a thorough draught of air through the room, and all slops and contents of chamber utensils should be immediately removed. No plants should be allowed in the bedroom; and, despite anything which may be urged to the contrary, it is very desirable to have the windows *always open* at the top for an inch or two in *all weathers.* The risk of catching cold is to a healthy person practically *nil,* and the ventilation obtained is of enormous value.

There is no better form of mattress than one made of horsehair, both for children and adults. The pillows should also be made of the same material. Both pillows and mattress should be taken to pieces once a year, and their contents well ventilated by exposure to the air. When a child is rickety, weak in the neck, inclined to stoop, or at all crooked, a pillow is best dispensed with. Cotton sheets have two advantages over

linen ones—they are more absorbent, and feel less cold. In cases of sickness the comfortable construction of the patient's bed, as well as the adoption of such means as shall ensure as much as possible its efficient ventilation, are matters of primary import. Hence because it permits of a more thorough circulation of air than any other kind, the horsehair mattress calls even more imperatively for adoption than in health. It may be placed upon the feather or wool bed, and should it be found too rough, or causing any discomfort, one or two blankets may be placed over it. The straw palliass should at the same time be removed. Both sheets and pillow-cases should be frequently changed, more especially in fevers. If the patient perspire very profusely, fresh sheets and pillow-cases should be supplied every twenty-four hours. If soiled by evacuation of any kind, it is most important that they should be changed at once, and so with the night-dress. In all cases of eruptive and other fevers, and contagious diseases, all articles of wearing apparel (underclothing, as well as sheets, pillow-cases, handkerchiefs, &c.) should when removed be placed in a vessel and covered with water, in which some suitable disinfectant such as carbolic acid may be dissolved.

Every bedroom should if possible contain an enclosed fireplace having free access to the chimney.

[On the connection of BEDS and BEDDING with comfort and health, see COTTON, DAMP, FEATHERS, LINEN, SLEEP, VENTILATION, VERMIN, &c.; also *below*.]

Bed, Air. Beds, pillows, cushions, &c., when properly constructed and inflated with air, are clean, luxurious, and healthy substitutes for those in common use. For this purpose the air-proof part should be formed of separate cells or tubes, arranged in ridges (see *engr.*), or in any similar manner to admit of free ventilation; and in the case of beds, or of cushions for the sick, two or three folds of flannel, or blanket, or of any loose porous fabric, should be placed between them and the under sheet or the person of the sleeper or patient. Without this precaution, discomfort and restlessness, excessive warmth and perspiration,

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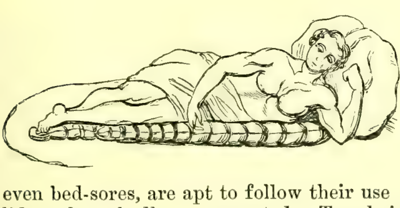

and even bed-sores, are apt to follow their use by invalids, when badly constructed. To obviate these objections to articles of this class commonly sold, a new one has been produced under the name of the 'INCOM'PARABLE BED' (Aycbourn's Patent), which is thoroughly applicable to all purposes—domestic, medical, naval, or military—and superior to any feather, flock, or spring bed, however good or carefully made up. This bed consists of an outer case made of ordinary bed-ticking divided internally into numerous separate cells, into each of which is placed a suitably constructed bag, which may be either wholly or partially filled with air or water; the latter either

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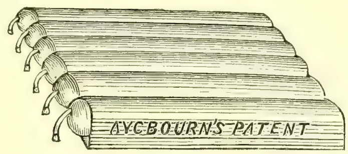

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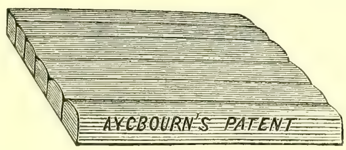

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hot or cold (see *engr.* 2, 3). It is incapable of bursting, and is very agreeable to lie on. It retains its shape, saves the time, trouble, and wear and tear ordinarily bestowed or produced by servants in daily tossing about one of down or feathers, is easily washed and kept clean, allows all the ventilation essential to health, and is so portable that it may be easily packed in a carpet-bag. In almost an instant it may be converted into six or more separate life-preservers, and, what is equally important, it will stand any climate.

Beds, Spring. Innumerable forms of spring beds are in the market; their prime cost is not very great and, inasmuch as they can be easily cleaned and save the use of mattresses, they are to be recommended.

Bed, Water. Water-beds, cushions, &c., are chiefly employed for patients labouring under bed-sores, paralysis, spinal affections, &c., or who are the subjects of active surgical treatment in which equable support for the body or a limb is absolutely necessary. Their construction and use are similar to those previously noticed, except that, instead of being inflated with air, they are filled with water, either warm or tepid. For the bed-ridden, and for long-continued use generally, they are much inferior to air-beds. See AIR-BED (*above*).

Beds, Wire. Woven wire is now much used in place of the sacking or laths stretched across the frame of the bed to support the mattresses and bedding, and recently mattresses constructed of spring wire have been introduced; they have the advantage of being easily removed and cleaned.

Bed. *Syn.* STRA'TUM, L.; STRATE, &c., Fr.; SCHICHT, &c., Ger. In *geology*, a mineral layer, seam, or stratum, thick or thin.

Bed. In *horticulture*, a small plot of land, usually raised a little above the general surface, in which flowers or other plants are raised or grown.

BEDDING, PURIFICATION OF, To be efficiently disinfected, bedding must be taken to pieces and subjected to dry heat. This last condition can only be satisfactorily carried out in

large ovens or disinfecting chambers. Any local authority may provide a proper place and necessary appliances for the disinfection of bedding. Any local authority may direct the detention of bedding, clothing, &c., which have been exposed to infection, and may give compensation for the same.

Any person giving, lending, selling, transmitting or exposing bedding, clothing, rags, &c., which have been exposed to infection, is liable to a penalty not exceeding £5.

Bedding or Litter. The following is from Lieut.-General Fitzwygram's work, 'Horses and Stables': "One great item in a horse's comfort, and consequently in his aptitude to carry flesh, is a good bed. Every horse should be bedded down at mid-day. As regards economy of straw, it is essential not to give the horse a chance of eating it. With this view no fresh straw should be placed within his reach. The fresh straw should be brought in first, and put not merely at the bottom, but also in rear of the stall; then the old litter should be brought in and put at the top and in front. The horse will not readily eat it, and by the following morning the new straw will have become somewhat tainted, and may then be mixed and dried along with the rest. Again, great care should be taken in the morning to thoroughly shake up and cleanse the bedding from dung; and any parts which may have become rotten should be thrown out. Good straw rapidly deteriorates if these precautions are not taken. On the other hand, careless servants often throw away along with the bad parts much good bedding which might be dried and used again. Bedding should be taken up, and turned over at least twice in each forenoon, so as to expose every part to the drying and purifying influence of the sun and air. It is, however, a mistake to expose it over much to the action of a very hot sun, as it makes it too dry and brittle." See HORSE.

Dried peat moss is now largely used by omnibus and tramway companies, and other large horse-owners. It is much more absorbent than straw and will last a much longer time, and when removed from the stables is far more valuable as a manure than the ordinary straw litter, as much more of the urine is absorbed by it. Another advantage which it has over straw, and which is important in large cities, where rents are high, is the comparatively small space it occupies, being compressed by hydraulic machinery into a very small bulk; further, horses will not eat it. The bracken fern if cut in early autumn, just after it has become brown, and properly dried and stacked makes fairly good bedding.

BED'EGUAR (-e-gahr). *Syn.* BÉDÉGUAR (or -GAR), Fr. Rose bedeguars: 'Robin Redbreast's pin-cushions.' Mossy excrescences often found on the common dog-rose (*Rosa canina*) in hedges; they are occasioned by the puncture of *Rhodites rosæ*, L. The bedeguars when cut across show the cavities containing the larvæ.

BEE (bē). *Syn.* HIVE-BEE, HON'EY-B. (hŭn'-), DOMES'TIC B.; A'PIS, L.; ABEILLE, A. MELLIFIQUE, &c., Fr.; BIENE, HONIGBIENE, &c., Ger. The *A'pis mellif'ica,* Linn. (Ph. L., E., & D.), one of the hymenop'tera best known and most useful to man.

BEECH (bēche). *Syn.* BEECH'-TREE; FA'GUS, L,; HÊTRE, H. COMMUN, Fr.; BUCHE, GEMEINE B., Ger. The *Fa'gus sylvat'ica,* Linn., a magnificent English forest-tree, of the Nat. Ord. AMENTACEÆ (DC). Fruit (BEECH'-MAST, B.-NUTS), used to feed swine, and, sometimes, in obstinate headaches, and in gravel complaints; yields oil by expression; inner bark occasionally used in hectic fevers. Wood (BEECH, B.-WOOD). handsome and very hard, but brittle and perishable, and particularly liable to become worm-eaten; its durability is increased by steeping it, when fresh-hewn, for some time in water; chiefly used by cabinet-makers, tool-makers, last-makers, coach-builders, millwrights, and turners; and, sometimes, by coopers; also burnt for charcoal.

Beech Oil. Obtained in France from beech-mast, is used for food and for burning. The refuse, after expressing the oil, is used as fuel.

BEEF (bēfe). *Syn.* CHAIRE DE BŒUF, Fr.; RINDFLEISCH, &c., Ger.; BU'BULA, CA''RO BO'VIS, &c., L. The flesh of bovine animals, generally; but ordinarily only that of the domestic ox, cow, or bull.

Qual. Good beef is highly wholesome and nutritious; and is well adapted to persons of good appetite, or that labour or take much exercise. For the delicate, especially those suffering from debility, partial anæmia, amenorrhœa, and similar ailments, it is, perhaps, superior to every other kind of animal food. If cooked so as to be left full of gravy, it sits lightly on the stomach, and its fat proves even more digestible than that of either veal or mutton.

Choice. OX-BEEF is known by having a fine smooth, open grain, a lively and agreeable red colour, and a tender texture, with the fat of a pale whitish-yellow or but slightly yellow, and the suet white and hard. When fine and well fed, the flesh is intergrained or marbled with fat. —COW-BEEF has a closer grain than ox-beef, and the lean is of a deeper red.—BULL-BEEF is closer still, the fat dark, hard, and skinny, the lean of a deep coarse red, and it has a strong smell and flavour.—HEIFER-BEEF resembles ox-beef, except in being smaller, often an advantage; but it lacks the rich flavour of the flesh of full-grown oxen.

Joints, Managem., &c. Beef is CURED, SALTED, and DRESSED, in all the ways common to the other meats; the only care necessary being in the selection of the appropriate joint or part. The ribs, sirloin, rump, and veiny piece are the proper joints for ROASTING OR BAKING. The buttock or round, edge-bone, second round or mouse-buttock, brisket, flank, shoulder or leg-of-mutton piece, and the clod, those generally BOILED, STEWED, OR SALTED. The choicest STEAKS are those cut from the middle of the rump; the next best from the veiny piece, or from the chuck rib. In summer, excellent ones may also be cut from the shoulder. Steaks cut from the sirloin (porter-house steak) are exceedingly delicate and tender. The neck may be either stewed or boiled, and is much used to make soup and gravy. In the country, the round, when fine, and well hung, is also often roasted or baked.

According to Miss Acton, "the finest part of the sirloin is the chump-end, which contains the

larger portion of the fillet; of the ribs, the middle ones."

Beef is in season during the whole year, but is finest—when it is most relished—during the winter months, when, owing to the temperature of the air, it may be 'hung' a long time, and thus increased in tenderness and flavour. See OX, BAKING, BOILING, ESSENCES, ROASTING, SALTING, TEA, &c. (also *below*).

Beef, Alamode′. *Syn.* BŒUF À LA MODE, Fr. The true 'beef à la mode' is made as follows; and is not a mere kind of rich stew, such as is daily sold under that name in the 'cook-shops' of London:

1. (*M. Alexis Soyer.*) Rump, sirloin, or rib of beef (about) 12 *lbs.*; lard it through with 10 or 12 long pieces of fat bacon; put it into an earthen pan with calf's foot, 4 onions, 2 carrots (sliced), a bunch of parsley, 2 bay leaves, 2 sprigs of thyme, 2 cloves, ½ teaspoonful of pepper, 1 do. of salt, 4 wine-glassfuls of sherry, 4 do. of water, and 1 *lb.* of streaky bacon (cut into small squares); place on the cover, make it air-tight round the edges with a little flour-paste, and expose it in a moderate oven for about 4 hours. Dish up with the vegetables and bacon placed tastefully round it, the gravy (skimmed) being poured over all. Or it may be eaten cold, in which case the pan should not be opened until the whole has thoroughly cooled.

2. (*Mrs Rundell.*) Rump of beef (or any part of the beef which will stew well), 3 or 4 *lbs.*; trim it, and cut off the fat; add several sorts (according to taste), of sweet herbs chopped very fine, a little shalot, and a great deal of spice (cayenne, white pepper, allspice, cloves, and mace; or mixed spices), and put them, with vinegar, into a saucer that has been rubbed with garlic; add fat bacon cut into long strips; lard the beef regularly on both sides, and rub it over with the herbs and spices; next flour it, and add a small piece of butter, and 1 pint of water; bake it in an oven until thoroughly 'done,' then strain the gravy, and serve it up with pickles on the top. Excellent either hot or cold.

Obs. Miss Acton—a high authority in these matters—tells us that 7 or 8 *lbs.* of beef, thus treated, takes 4 to 5 hours to dress it properly; and that if a stew-pan be used, it should be as nearly the size of the meat as possible, the whole being allowed to simmer very gently, and the meat turned when half done. She also states that "veal dressed in this way is even better than beef," but it takes less time in cooking,

Beef, Col′lared. *Prep.* 1. (*Miss Acton.*) The piece of beef is rubbed with a little coarse sugar, and set aside for two or three days; it is then slightly salted (about 1 *oz.* of salt, containing a little saltpetre, to each *lb.* of meat); and allowed to rest 8 to 10 days; the bones and tougher skin are next removed, and the under side is sprinkled thickly with parsley and other savoury herbs (shred small), after which it is very tightly rolled up, secured with a cloth, and bound as closely as possible with broad tape. A piece of 8 *lbs.* will require about five hours' gentle boiling, and should be placed, in the same state, whilst still hot, under a heavy weight, or in a press, for a few hours. The ribs, or (better) the thinnest part of the flank, is generally selected. The last should be 'hung' in a damp place for a day or two before curing it.

2. (*Mrs Rundell.*) From stewed shin of beef and ox-tail, re-stewed with a glassful each of wine and ketchup and some of the old broth, and then poured into moulds. Sweet herbs, sliced eggs, and pickles may be added at will.

Beef, Dutch, Hung Beef. The round, rump, veiny piece, or thick flank, cured, for ten or twelve days, with dry salt to which a little saltpetre and some sugar and black pepper has been added; and afterwards 'hung' for use. It eats well if boiled tender with greens or carrots. If to be grated or shred, as Dutch, and eaten as a relish on bread and butter, then cut a lean bit, boil it till extremely tender, and while hot put it under a press. When cold, fold it in a sheet of paper, and hang it in a very dry place. It will then keep two or three months.

Beef, Pott′ed. See POTTED MEATS, &c.

Beef, Spiced (spīst). Salted beef when spices (usually black pepper and allspice) have been added to the salt, &c., used in curing it. See BEEF, COLLARED (*above*).

Beef Tea. The object of beef tea is to provide a patient, unable to take solid food, with something that shall be at the same time nutritive and stimulant; and in *properly made* 'beef tea' these qualities are united, though the latter is, perhaps, the more important. The popular idea as to making beef tea is to prepare a stiff and more or less savoury jelly from the bone, tendon, and small portion of meat to be found on a 'shin of beef.' Such a jelly, consisting, as it does, almost entirely of gelatine, though more pleasant to the taste, is hardly more nutritive or stimulating than if it had been prepared from the proper quantity of glue; for it cannot be too strongly urged that *gelatine is not a food.* In the healthy stomach the residue, after digestion of a piece of lean meat, is exceedingly small; but, inasmuch as invalids are often incapable of taking meat, it is desirable to give them so much of it as can by ordinary means be obtained in solution. Practically only a small proportion of the nutritive matter of meat can be obtained as beef tea, however well prepared; but the so-called extractives, which have a very important though little understood stimulating action, can be to a large extent removed from meat by boiling and obtained in solution. Further, some of the albumenoids of meat are soluble in water containing a trace of salt; so that by proper use of the salt required for seasoning, which is amply sufficient for the purpose, the nutritive qualities of the extract can be largely increased. At a boiling temperature these albumenoids are almost all coagulated, so that it is desirable not to heat beef tea, in the course of preparation, to boiling, otherwise there will be a loss of nutritive quality. Bearing these three facts in mind, viz. (1) that gelatine is *not* a food; (2) that beef tea is rather to be regarded as valuable for the 'extractives' it contains, and is more stimulating than nourishing; and (3) that the albumenoids of meat, *i.e.* the nutritive portion, are to some extent soluble in weak solutions of common salt, the following process for making beef tea will explain itself.

Take 1 lb. of the very best steak—without fat, bone, or gristle; cut it up into small pieces the size of horse-beans on a dish; wash all the juice which runs out into a basin, along with the shred meat; now add sufficient salt to flavour 1 pint; add ½ pint more water and allow to stand an hour or two, stirring occasionally; then heat gradually in a slow oven, or set the basin in a saucepan partly filled with water *near* the fire, *not on it;* and allow it to heat gradually for some time, continuing the process until the original 1½ pints of water is reduced to about 1 pint. Pour off the extract into a basin and allow it to cool, so that the fat can be *entirely* removed. When required for use, warm just so much as the patient requires, and no more. It must be remembered that beef extract so prepared is about the most perfect cultivating medium for bacteria known; the greatest care should therefore be taken to prevent its decomposing, and for this purpose it is best to make only small quantities at a time.

A very nourishing but somewhat disgusting beef tea can be prepared by shredding meat very finely into water containing a little salt, allowing it to stand awhile, and straining off the liquor, which is then ready for use. See also under EXTRACT.

BEER (bēre). *Syn.* BIÈRE, Fr.; BIER, D., Ger.; BIRRA, Ital.; CERVESA, Sp.; CEREVISIA (-vĭzh'-ă) (*Pliny*), VINUM ANGLICANUM, L.; ζύθος, Gr.; BEERE, Sax.; BIR, W. An aqueous infusion of malted grain, which, after having been boiled with hops, has undergone alcoholic fermentation; malt-liquor. The word BEER is now the common generic term for all fermented malt liquors, and, indeed, for all such beverages as have been prepared by the process of brewing as described hereafter. Whenever the term is used in a special sense; it is with a descriptive prefix as, for example, spruce-beer, ginger-beer, &c.

History. Ale, wines, and fermented liquids of a similar nature have been used as beverages since so remote a time that it is impossible to fix their origin. Probably the first mention of the art of brewing is made by Herodotus, who ascribed its origin to Osiris (1960 B.C.), and who notices zythum (ζύθος) or fermented barley wine. Though a certain amount of doubt may attach to this statement, it is perfectly certain that malt liquor was employed as a beverage many centuries before Christ. It is unmistakably referred to by Æschylus (470 B.C.), Sophocles (420 B.C.), Xenophon (401 B.C.), Theophrastus (300 B.C), and other ancient writers. Of ancient beers, that made at Pelusium, at the mouth of the Nile, and known as the Pelusian Potation, was most celebrated for its excellency. Beer was used by the Gauls and Scandinavians at all their festive meetings, and was early known in our own country, the art of its preparation having been most probably obtained from the Saxons. In the 13th century ale was drunk generally in England, and in 1492 we find that a licence was granted to a Greenwich brewer to export 50 tons of that 'ale called 'beere;' the distinction between the two apparently being that the latter was flavoured with wormwood or other bitters, whereas ale was not. Hops, which in the 11th century had been found by the Germans to possess valuable flavouring and preservative qualities, were not introduced into England until A.D. 1524, and the origin of beer, properly so called, may be fixed at this date. By statute of James I. 'bere' was taxed, and the price of "one quart of the best thereof" fixed at one penny (A.D. 1610).

Var. The numerous varieties of malt liquors met with in commerce may be classified broadly as follows:

1. *Pale Ales.* Manufactured from very pale, light-dried malt and the choicest hops.

2. *Bitter Ales.* In these the attenuation is carried to a considerable extent; that is, they are very alcoholic, and are in addition highly hopped.

3. *Mild Ales.* In beers of this class there is less attenuation, so that there is less alcohol and more malt extract, together with a smaller quantity of hops.

4. *Porter.* About the same attenuation as mild ales, from which it differs chiefly in being artificially coloured by the use of roasted malt, and in containing less hop extract, the roasted malt imparting to it a characteristic flavour.

5. *Stout.* This beer has a higher original gravity than porter, and is even less attenuated. Less hop is also used, the caramelised substances of the roasted malt acting as preservatives.

6. *Lager.* This beer, produced principally in Germany, has a comparatively low original gravity, and less attenuation than an English beer of the same gravity. It is rich in dextrin and carbonic acid, and, owing to the smaller quantity of hops used, contains less of their narcotic principles.

The six classes of malt liquors referred to above are practically subdivided into an indefinite number of varieties. Every county, every town, and almost every brewer is distinguished by the production of a different flavoured beer, readily recognised by those accustomed to its use. Just as indefinite as the number of varieties above referred to are the causes of such varieties; slight differences in the quality of the water, malt, hops, &c., used, and in the mode of carrying out the various operations, being quite sufficient to affect the flavour of a brewing. The greater differences produced by the alteration of the relative quantities of malt, water, &c., will be discussed in another section.

Comp. The differences noticed in the various beers are due rather to the varying quantities of certain common constituents than to variations in the constituents themselves. Water, alcohol, maltose, dextrin, albumenoid substances, carbonic acid, lactic acid, succinic acid, acetic acid, hop extract, and small quantities of mineral matter are substances common to all beers; whilst malic acid and various complex organic bodies are usually present in smaller quantities.

The alcohol and succinic acid are formed during the fermentation of the wort from the maltose contained therein, whilst the acetic acid is the product resulting from the oxidation of a small quantity of the alcohol.

The mineral matter, which varies from about 0·1% to 0·4%, is derived partly from the water used, partly from the malt, and partly from the hops.

The following is the average composition of the ash of beer:

Potash	38·35
Soda	7·68
Lime	2·45
Magnesia . . .	3·78
Sulphuric acid . .	1·36
Chlorine.	2·75
Phosphoric acid . .	33·76
Silica	9·87
	100·00

In English beers the percentage of malt extract is greatest in mild ales and least in bitter ales, whilst the opposite is the case with the hop extract. The amount of carbonic acid varies from ·1% to ·5%, being usually greater in German lager than in English beers. The total solid matter and the alcohol vary, of course, considerably, according to the original gravity and to the amount of attenuation that the beer has undergone. In English beers the percentage of alcohol varies from about 4% to about 8%, and the total solid matter from about 3% to 12%. The percentage of albumenoid bodies, calculated from the total nitrogen, averages about 0·5%, and by the moist combustion process with boiling alkaline permanganate, from about 0·15% to 0·7%. With English ales Dr Graham adopts the factor ·01 of albumenoids, as given by the moist combustion process, for every 1 lb. per barrel of original gravity. Thus a 20-lb. original gravity beer (1056° sp. gr.) should not yield more than $\cdot 01 \times 20 = 0{\cdot}2\%$ albumenoids.

The following analyses of various beers by Dr Chas. Graham, taken from his paper read before the Society of Arts in 1881, may be looked upon as representative of the composition of the different classes of beer:

	Burton.		Somersetshire.	Scotch.		Dublin Stout. xxx.	German.	
	Mild.	Bitter.	Old Vat Ale 3 years.	Mild.	Bitter.		Vienna.	Pilsen.
Maltose	2·13	1·620	1·363	1·50	0·87	5·350	1·643	0·690
Dextrin	3·64	2·601	1·963	1·86	1·45	2·090	2·736	2·650
Albumenoids (Wanklynised)	0·26	0·156	0·705	0·35	0·30	0·430	0·365	0·200
Lactic and succinic acids .	0·18	0·171	0·630	0·14	0·10	0·252	0·126	0·090
Colouring matter, hop extract, ash, &c. (by difference)	0·53	0·876	0·835	0·23	0·48	1·400	1·121	0·590
Total solids	6·74	5·424	5·496	4·08	3·20	9·522	5·991	4·220
Acetic acid	0·01	0·015	0·225	0·03	0·02	0·036	0·024	0·020
Alcohol by weight . . .	6·78	5·440	8·570	4·62	5·50	6·780	4·690	3·290
Water by difference . . .	86·47	89·121	85·709	91·27	91·28	83·662	89·295	92·470
	100·00	100·000	100·000	100·00	100·00	100·000	100·000	100·000
Original gravity	1080°	1064°	1085°	1053°	1057°	1089°	1058·6°	1040·3°
Ratio of maltose to dextrin .	$\frac{1}{1\cdot7}$	$\frac{1}{1\cdot6}$	$\frac{1}{1\cdot38}$	$\frac{1}{1\cdot2}$	$\frac{1}{1\cdot7}$	$\frac{1}{0\cdot39}$	$\frac{1}{1\cdot66}$	$\frac{1}{3\cdot8}$

The total amount of free acid (lactic, acetic, succinic, &c.) varies from 0·1% to 0·3% and increases with age, the sample of Somersetshire ale, 3 years old (see above table), containing ·85% total free acids.

Adulteration. From 1816 to 1862 nothing was allowed to enter into the composition of beer but malt and hops, and the Act 56 Geo. III, cap. 58, imposes a penalty of £200 on any 'brewer, dealer, or retailer of beer' who 'shall receive or have in his possession, or use, or mix with, or put into any worts or beer any molasses, honey, liquorice, vitriol, quassia, cocculus indicus, grains of paradise, Guinea pepper, or opium, or any extract or preparation of these substances, for, or as a substitute for, malt or hops.' With the abolition of the hop duty in 1862 that part of the above Act prohibiting the use of substitutes for hops was repealed (Act 25 Vic., cap. 22, s. 20). In 1847 an Act (10 Vic., c. 5) was passed allowing brewers to use sugar under certain restrictions, and in 1874 the use of any saccharine material was permitted. The 'Beer Act' of 1880, finally, gives to brewers almost perfect freedom in the choice of brewing materials. The 'Sale of Food and Drugs Act' of 1875, with its amendment of 1879, is the Act under which adulteration of beer by the brewer would now come. As the law now stands, a brewer may use hop-substitutes, sugar, syrups, and malt-substitutes (raw grain, &c.), provided the above are not injurious to health. The use of any harmless bitter (*e.g.* quassia and gentian) is perfectly legal, but the employment of such poisonous bitter substances as picric acid and picrotoxin is strongly to be condemned. The adulteration of beer with substances injurious to health is, happily, at the present day a matter of very rare occurrence. Cocculus indicus, grains of paradise, capsicum, opium, and tobacco are amongst the bodies that have been used by dishonest and disreputable dealers to give pungency and intoxicating properties to a weak beer, and so disguise its bad quality. The method of detecting picric acid is

given in a subsequent section. Salicylic acid, which is occasionally used as a preservative, cannot be looked upon as a sophistication, since, in the small quantities in which it is employed, it has not been proved to be injurious to health. The dilution of beer with water and the addition of sugar by the publican are offences punishable by the Excise authorities. The presence in beer of a large quantity of common salt must be regarded as an adulteration, for the properties of the beer containing it are not those expected by the purchaser—that is to say, it creates instead of quenching thirst. Anything above 50 gr. per gall. is to be looked upon with suspicion.

Examination, Tests, &c. A complete quantitative analysis of beer is a matter of considerable difficulty, and can only be accurately effected by an experienced chemist. The following processes, however, may be made use of to determine the alcohol, total solid matter, ash, &c., and to detect injurious adulterations such as picric acid, picrotoxin, and narcotics.

1. *Determination of Alcohol.* The amount of alcohol in a sample of beer is most accurately determined as follows:

Moderately 'toss' a quantity of the beer in order to expel carbonic acid, and measure out carefully 200 c.c. at 60° F. (=15·5° C.). Carefully neutralise any free acid with sodium carbonate. Transfer this to a flask capable of holding about 500 c.c., and connected with a condenser through which a stream of cold water is passing. Rinse out the measuring-flask with distilled water several times, taking care that not more than 100 c.c. are used in all for this purpose, and add the rinsings to the beer in the distillation-flask. This is then heated to boiling, and the distillate (alcohol and water) is caught in the flask in which the beer was measured. When about 180 c.c. have been distilled over, the lamp is removed and the distillate, brought to a temperature of 15·5° C., is made up to the 200 c.c. mark with distilled water. The specific gravity of this solution is then taken very carefully by means of a specific gravity bottle, and the amount of alcohol is found from this number by referring to a table constructed for the purpose. Thus, a sample of beer giving a distillate having a specific gravity of 990·9 (water =1000) will be found on referring to a table to contain 5·31% of absolute alcohol by weight. Tables giving percentages of absolute alcohol and proof-spirit corresponding to various specific gravities have been published by Dr Stevenson and Mr O. Hehner.

2. *Original Gravity.* The original gravity of a beer is the sp. gr. of the wort from which the beer was prepared, prior to fermentation. During the fermentation process a part of the saccharine matter contained in the wort is decomposed into alcohol and carbonic acid gas, the former being found in the beer, the latter escaping into the air; hence it is evident that in the beer we have a certain amount of unfermented matter, together with a quantity of alcohol corresponding to that part of the sugar material which has undergone decomposition. In other words, if the number of degrees of gravity lost during the fermentation process, corresponding to a given quantity of alcohol be known, and if this number be added to the sp. gr. of the residual unfermented matter, the sp. gr. of the wort or the 'original gravity' of the beer will be obtained. Careful experiments have been made with the object of showing the loss of degrees of gravity corresponding to various percentages of alcohol, and the results have been stated in tabulated form for use in determinations of original gravities by the following method, known as the 'Distillation method.'

The first part of the process resolves itself into a determination of the amount of alcohol in the manner described in the preceding section. The residue in the distillation-flask (matter that has not undergone fermentation) is then dissolved in distilled water and made up to 200 c.c. at 15·5° C. Its sp. gr. is then taken as in the case of the alcoholic distillate. The sp. gr. of the distillate (which must necessarily be less than 1000) is subtracted from 1000, giving a number termed the 'spirit indication.' On referring to a table constructed for the purpose, the number of degrees of gravity lost during the fermentation process corresponding to the 'spirit indication' found is obtained. This number added to the sp. gr. of the residue gives the original gravity of the beer. In the table here referred to an allowance is already made for the formation of 0·1% acetic acid from the alcohol—an amount larger than is ever found in sound ale,—and only in the case of a sour beer need any correction be applied. A set of tables, published by Messrs Townson and Mercer, will be found to give all the numbers required in determining the alcohol and the original gravity by the methods here described.

Example.—A sample of beer was distilled in the manner described above:

Specific gravity (water = 1000) of the distillate 990·2°.

$$1000 - 990{\cdot}2 = 9{\cdot}8 \text{ 'spirit indication.'}$$

On referring to a table it will be seen that 9·8 'spirit indication' corresponds to 43·2 degrees of gravity lost during fermentation.

Specific gravity of residue . .	1014·3°
Add, degrees of gravity lost .	43·2°
Original gravity of beer .	1057·5°

3. *Total Solid Matter.* 10 c.c. of the beer are evaporated to dryness in a weighed platinum or glass dish, and the residue dried on the water-bath to a constant weight.

4. *Mineral Matter.* The above residue, after weighing, is, if in a platinum dish, ignited to a white ash at the lowest possible heat and weighed. The chlorine may be determined by evaporating 100 c.c. of the beer to dryness in a platinum dish, and charring the residue; if burnt to a white ash some of the sodic chloride would volatilise. The charred residue is then boiled several times with distilled water, and filtered off. A drop of nitric acid is added to the clear filtrate, and the chlorine precipitated by addition of silver nitrate solution. The precipitated silver chloride is filtered off, thoroughly washed, dried, and weighed after ignition. Each grain of this precipitate is equal to 0·4 gr. of common salt.

5. *Picric Acid.* A quantity of the beer is agitated in a separating-funnel with half its

volume of pure amylic alcohol. The alcoholic layer is separated, and on evaporating in a small porcelain dish, the picric acid, if present, will be left behind. A little distilled water is added, and then some concentrated solution of potassic cyanide. On warming a blood-red colour will appear, owing to the formation of potassium isopurpurate. Picric acid may also be detected by boiling some unbleached sheep's wool in the acidified beer for some minutes. If picric acid be present, the wool will be found on washing to have acquired a yellow colour.

6. *Picrotoxin.* This substance, the poisonous principle of the fruit of *Menispermum cocculus*, can be detected by the following process, due to Herepath:

A quantity of the beer is treated with excess of lead acetate solution, and the resulting precipitate filtered off. Sulphuretted hydrogen is passed into the filtrate to remove excess of lead, and the lead sulphide separated. The concentrated filtrate is treated with animal charcoal, which absorbs the picrotoxin. The charcoal is filtered off, washed, dried at 100° C., and boiled with alcohol, which, on evaporating and cooling, deposits silky needles of picrotoxin. The crystals may be dissolved in dilute caustic potash and warmed with a solution of copper and potassium tartrate, when a red precipitate of copper suboxide is obtained.

7. *Narcotics.* The following process may be adopted for the extraction of narcotic substances from the beer, their further identification being effected by subsequent tests for the alkaloids, &c. Half a gallon of the beer under examination is evaporated to dryness on a water-bath; the residue is boiled in a closed vessel with 10 or 12 fl. oz. of rectified spirit for from thirty to forty minutes, the mixture being occasionally stirred. The alcohol solution is then filtered, treated with sufficient acetate of lead to precipitate colouring matter, and again filtered; the filtrate is treated with a few drops of dilute sulphuric acid, again filtered, and evaporated to dryness. It may then be tested with any of the usual alkaloid reagents, either in the solid state or in aqueous solution.

8. *Salicylic Acid.* This substance may be easily detected by agitating the beer, previously acidified with hydrochloric acid, in a separating funnel with about half its volume of ether. The ethereal layer, which rises to the top, is separated and evaporated to dryness. The residue is dissolved in water, and a few drops of a dilute solution of ferric chloride are added, when, if salicylic acid be present, an intense violet colouration will result.

*** Besides malt liquor, or BEER properly so called, a somewhat similar beverage, though of inferior quality, may be prepared from any vegetable substance rich in starch and sugar, as noticed in our article on BREWING. Certain summer beverages also pass under the name; but in both the cases referred to, the name of the characteristic ingredient, or that of the vegetable employed, is always conjoined; as in pea-shell beer, potato beer, ginger beer, &c. Examples of some of these are given below.

Beer, Gin'ger. *Syn.* CEREVIS'IA (-vĭzh'-) ZINGIB'ERIS, C. ZINGIBERA'TA*, C. CUM ZINGIB'ERE* (-ĕr-e), L. *Prep.* 1. Lump sugar, 1 *lb.*; good unbleached Jamaica ginger (well bruised), 1 *oz.*; cream of tartar, ¾ *oz.* (or tartaric acid, ½ *oz.*); 2 or 3 lemons (sliced); boiling water, 1 gall. Macerate, with frequent stirring, in a covered vessel, until barely lukewarm, then add of yeast, 1½ or 2 *oz.* (about 2-3rds of a wineglassful), and keep it in a moderately warm place, to excite a brisk fermentation; the next day rack or decant the liquor, and strain it through a jelly-bag or flannel; allow it to work for another day or two, according to the weather; then skim it, again decant or strain, and put it into bottles, the corks of which should be 'wired' down.

2. Good white sugar, 18 to 24 *lbs.*; lemon-juice or lime-juice, 1 quart; finest Narbonne honey, 1 or 2 *lbs.*; bruised Jamaica ginger, 1½ *lbs.*; pure soft water (that has been boiled, and then allowed to settle), q. s. Boil the ginger in 3 galls. of the water for half an hour; then add the sugar, the juice, and the honey, with sufficient water (see *above*) to make the whole measure 18¼ galls., and strain the mixture as before. When the liquor has become almost cold, add the white of 1 egg, and ½ *fl. oz.* of essence of lemon, and strongly agitate the cask or vessel for about half an hour. After standing 3 to 6 days, according to the state of the weather, bottle it, and place the bottles on their sides in a cellar, just as is done with wine or beer. It will be ready for use in about three weeks, and will keep good for several months. If wanted for immediate use, about ½ pint of yeast may be added, as in formula 1; but then it will not keep so well, or be quite so transparent and free from deposit. The lemon-juice and essence of lemon may be replaced, at will, by cream of tartar (in powder) or tartaric acid 4 *oz.*, and lemons (sliced) 1½ to 2 doz., added with the sugar, &c.; but the original formula is preferable.—*Prod.* 18 galls. = 24 doz. ½-pint bottles, or 30 doz. ordinary sized ones.

3. EXTEMPORANEOUS:—(*a*) Into each bottle put concentrated essence of ginger, 1 drop; simple syrup or capillaire, ½ *oz.* (or in lieu of them, syrup of ginger and simple syrup, of each, a dessert-spoonful); and fill with aërated soda-water at the 'bottling machine,' in the usual way. Very superior.

(*b*) Into each bottle put 2 or 3 lumps of sugar, fill them to the proper height with pure water, throw in (quickly) an effervescing ginger-beer powder, and instantly cork the bottle, and secure the cork with wire.

Use. As a cooling and refreshing drink in warm weather; and as a restorative after hard work, fatigue, &c.

Obs. The products of all the above formulæ, if well managed, are excellent; those of Nos. 2 and 3 (*a*) of the very finest description, much stronger and superior to nine tenths of that sold for the best in the shops. They are often called, by way of distinction, LIMO''NIATED GINGER BEER, IMPERIAL G. B., &c. Cheaper articles are made by omitting some of the ingredients, and particularly a portion of the sugar. The ginger beer vended at 1*d.* and 2*d.* a bottle, with that known as GINGER POP, IMPE''RIAL POP, &c., are generally made with moist sugar (½ to ¾ *lb.* to the gall.), and merely flavoured with a little coarse ginger. No. 2, made with 2 *lbs.* of sugar to the

gall., may be kept 2 years, if not bottled for six months, and well stored; and with 3 *lbs.* to the gall., for 4 years, when it forms a splendid article (GINGER CHAMPAGNE).

Beer, Pine. See BEER, SPRUCE.

Beer, Spruce. *Syn.* CEREVIS'IA (-vĭzh'-) ABI'ETIS, C. ABIETI'NA, C. ABIET'ICA*, L. *Prep.* 1. Sugar, 1 *lb.*; essence of spruce, ½ *oz.*; boiling water, 1 gall.; mix well, and when nearly cold, add of yeast ½ a wineglassful; and the next day bottle like ginger beer.

2. Essence of spruce, ½ pint; pimento and ginger (bruised), of each, 5 *oz.*; hops, ½ *lb.*; water, 3 galls.; boil the whole for 10 minutes, then add of moist sugar, 12 *lbs.* (or good treacle, 14 *lbs.*); warm water, 11 galls.; mix well, and, when only lukewarm, further add of yeast, 1 pint; after the liquid has fermented for about 24 hours, bottle it.

Prop., Uses, &c. Diuretic and antiscorbutic. Regarded by some persons as an agreeable 'summer drink,' and often found useful during long sea voyages. When made with lump sugar it is called WHITE SPRUCE BEER; when with moist sugar or treacle, BROWN SPRUCE BEER. An inferior sort is made by using less sugar or more water. If made with 1¼ to 1½ *lbs.* of lump sugar per gall., and without yeast, in a similar manner to that described under GINGER BEER (No. 2), it may be kept a twelvemonth or longer in a moderately cool place.

Beer, Sugar. *Syn.* CEREVIS'IA (-vĭzh'-) SAC'-CHARI, L. From moist sugar (1 to 2 *lbs.* to the gall.) and a little hops, as treacle beer.

Beer, Trea'cle (trē'kl). *Syn.* CEREVIS'IA FÆ'CIS SAC'CHARI, &c., L. *Prep.* 1. From treacle or molasses, ¾ to 2 *lbs.* per gall. (according to the desired strength); hops, ¼ to ¾ *oz.*; yeast, a tablespoonful; water, q. s.; treated as *below*.

2. Hops, 1½ lbs.; corianders, 1 *oz.*; capsicum pods (cut small), ½ *oz.*; water, 8 galls. Boil for 10 or 15 minutes, and strain the 'liquor' through a coarse sieve into a barrel containing treacle, 28 *lbs.*; then throw back the hops, &c., into the copper, and reboil them, for 10 minutes, with a second 8 galls. of water, which must be strained into the barrel as before; next 'rummage' the whole well with a stout stick, add of cold water 21 galls. (sufficient to make the whole measure 37 galls.), and, after again mixing, stir in ½ a pint of good fresh yeast; lastly, let it remain for 24 hours in a moderately warm place, after which it may be put into the cellar, and in two or three days 'bottled,' or 'tapped' on 'draught.' In a week it will be fit to drink. Very superior.—*Prod.* 1 barrel or 36 galls. For a stronger beer, 36 *lbs.*, or even ½ *cwt.*, of treacle may be used. It will then keep good for a twelvemonth.

Obs. A wholesome drink, but one apt to prove laxative when taken in large quantities. See BEER, BREWING, GINGER, POWDERS, &c.

Beer, Wheat'en. Wheat-malt beer. See MUM.

BEERS (in *pharmacy*). *Syn.* CEREVIS'IÆ (-vĭzh'-e-ē) MEDICA'TÆ, L. The general nature and preparation of these articles have been already noticed (see ALES, MEDICATED). They are little employed in this country. The ingredients should be so proportioned that from ¼ to ½ a pint may form the proper dose. The following are examples:

Beer, Antiscorbu'tic. *Syn.* CEREVIS'IA ANTI-SCORBU'TICA, L.; SAPINETTE', Fr. *Prep.* 1. (P. Cod., 1839.) Scurvy-grass and buds of the spruce fir, of each, 1 oz.; horse-radish root, 2 oz. (all fresh, and bruised or sliced); new ale or beer, 3½ pints (say ½ gall.). Macerate 4 days, press, and strain for use.

2. (Ph. Castr. Ruth., 1840.) Horse-radish (fresh), 4 lbs.; juniper berries, 3 *lbs.*; root of *Calamus aromaticus* and buds of *Pinus abies*, of each, 1 *lb.*; ginger, 1 *oz.*; syrup (of brown sugar), 6 *lbs.*; beer, 120 *lbs.* (say 12 galls.). Macerate 4 days, or until it ferments, then decant, strain, and add of cream of tartar, ½ *lb.*; tincture of mustard (flour of mustard 2 *oz.*, to proof spirit 12 *oz.*), 5 *lbs.* (say ½ gall.). In scurvy, &c.

Beer, Cincho'na. *Syn.* A'GUE BEER, BARK BEER; CEREVIS'IA CINCHO'NÆ, &c., L. *Prep.* 1. Bruised cinchona bark, 1 *oz.*; proof spirit or brandy, 2 *oz.*; mix; the next day add of new beer, 1 qt., and in 3 days decant or filter.—*Dose*, 2 or 3 wineglassfuls.

2. (*Mutis.*) Cinchona, 4 *oz.*; sugar, 2 *lbs.*; boiling water, 5 *pints*; when lukewarm, ferment with a little yeast, as for ginger beer.—*Dose*, 1 or 2 wineglassfuls.

3. (Ph. Ferrara.) Bruised Peruvian bark, 1½ *oz.*; cinnamon, 2 *dr.*; nutmeg (rasped), 7 *dr.*; sugar, 25 *oz.*; yeast, 2 *oz.*; water, 5 pints; mix, ferment, decant, and strain as before.—*Dose*, 3 or 4 wineglassfuls. They are all administered during the intermission of ague.

Beer, Pipsissewa. *Syn.* CEREVIS'IA CHIMAPH'-ILE, &c., L. *Prep.* (*Dr J. Parrish.*) Pipsissewa (*Chimaphila umbellata*), ½ *lb.*; water, 1 gall.; boil, strain, add of sugar, 1 *lb.*; powdered ginger, ¼ *oz.*; yeast, q. s.; and ferment, strain, and bottle as for ginger beer. In scrofulous affections, especially of the joints.—*Dose.* Half a tumblerful. It is a favourite remedy with some American practitioners.

Beer, Sarsaparil'la. *Syn.* LIS'BON DI'ET BEER, SPAN'ISH JARAVE; CEREVIS'IA SAR'ZÆ, C. SAR-SAPARIL'LÆ, INFU'SUM S. PARA'TUM FERMENTA-TIO'NE, &c., L. *Prep.* 1. Compound extract of sarsaparilla, 1½ *oz.*; hot water, 1 pint; dissolve, and when cold, add of good pale or East India ale, 7 pints.

2. Sarsaparilla (sliced), 1 *lb.*; guaiacum bark (bruised small), ¼ *lb.*; guaiacum wood (rasped), and liquorice root (sliced), of each, 2 *oz.*; aniseed (bruised), 1½ *oz.*; mezereon root bark, 1 *oz.*; cloves (cut small), ¼ *oz.*; moist sugar, 3½ *lbs.*; hot water (not boiling), 9 qts. Mix in a clean stone jar, and keep it in a moderately warm room (shaking it twice or thrice daily) until active fermentation sets in; then let it repose for about a week, when it will be fit for use.

Obs. It is said to be superior to the other preparations of sarsaparilla as an alterative or purifier of the blood, particularly in old affections. That usually made has generally only one half the above quantity of sugar, for which treacle is often substituted; but in either case it will not keep well; whereas, with proper caution, the products of the above formulæ may be kept for one, or even two years. No yeast must be used.—*Dose.*

A small tumblerful 3 or 4 times a day, or oftener.

Beer, Stomach'ic. *Syn.* MED'ICATED PURL; CEREVIS'IA STOMACH'ICA, L. *Prep.* (*Dr Quincy.*) Centaury tops and Roman wormwood, of each, 4 handfuls; gentian root (bruised), 2 *oz.;* the yellow peels of 6 Seville oranges; Spanish angelica root and Winter's lard, of each (bruised), 1 *oz.;* new ale or beer, 3 qts. (say 1 gall.); digest for a few days as before. One or two wineglassfuls early in the morning, and an hour before a meal.

Beer, Sulphu''ric Acid. *Syn.* SULPHURIC LEMONADE; CEREVISIA ACIDI SULPHU''RICI, C. ANTICOL'ICA, L. *Prep.* 1. Treacle beer, or other weak mild beer or ale, to which a little concentrated sulphuric acid has been added, in the proportion of about 1 dr. to every 8 or 10 pints; the whole being well agitated together, and allowed a few hours to settle.

2. Treacle, 14 *lbs.;* bruised ginger, $\frac{1}{2}$ lb.; coriander, $\frac{1}{2}$ *oz.;* capsicum and cloves, of each, $\frac{1}{4}$ *oz.;* water, $12\frac{1}{2}$ galls.; yeast, 1 pint; proceed as for ginger beer, and when the fermentation is nearly over, add of oil of vitriol, $1\frac{1}{2}$ *oz.* (diluted with 8 times its weight of water), and of bicarbonate of soda, $1\frac{1}{2}$ *oz.* (dissolved in a little water). It is fit to drink in 3 or 4 days.

Uses, &c. It is taken with great benefit by workers in lead, especially by those employed in white-lead works; also in cases of lead colic, poisoning by lead or its salts, &c. A tumblerful twice or thrice daily. It is both harmless and wholesome.

Beer, Tar. *Syn.* CEREVIS'IA PI'CIS, C. P. LIQ'UIDÆ, L. *Prep.* (*Duhamel.*) Bran, 2 pints; tar, 1 pint; honey, $\frac{1}{2}$ pint; water, 6 pints; mix, and gently simmer together for 3 hours; when lukewarm add of yeast, $\frac{1}{2}$ pint; let it ferment for 36 hours, and strain. Pectoral, anti-asthmatic, anti-phthisic, &c.—*Dose.* One wineglassful before each meal, in bronchial and chest diseases and incipient consumption. See BEERS (in *pharmacy, above*).

BEES. *Varieties.* The English honey-bee, *Apis mellifica*, and the Italian or Ligurian bee, *A. ligustica*, are those best known in Europe, and most generally kept for producing honey. There are two African bees, *A. fasciata* and *A. Adansonii*, which have been described as distinct species, but the general opinion of authorities on the subject is that they are probably only varieties of one and the same species.

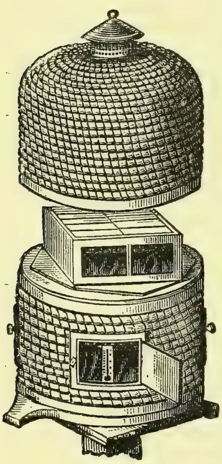
The honey-bee is distinguished from almost all other insects by the singular division of the family into queen bees, workers, and drones, the queen being the only perfect female, the drone the male, and the workers imperfect females. It is the custom of the honey-bee to tolerate only one queen at a time in each hive or family; thus the increase of that family is entirely dependent upon her. The number of eggs laid by the queen under favourable conditions, according to Dzierzon, is about 60,000 per month during the season, and a specially fertile queen, during the four years which is the average of her life, will lay more than a million of eggs. Though as far as size and general appearance are concerned these eggs are all exactly alike, the question of which egg shall produce a queen is determined not by the egg itself, but by the subsequent treatment of the larva. Queens are not raised in a hive unless, if it can so be said, in the opinion of the bees there is need of them; and in order to effect this the workers select certain eggs, or even larvæ as much as three days old, and build around them a large cell, differing entirely from the ordinary form, and feed them with a special food known as Royal Jelly. This special food has the property of effecting a complete metamorphosis in the development of the larvæ; it is supplied to them in very large quantities, and the development of the organs appears to be thereby greatly accelerated, so that on the sixteenth day from the deposition of the egg the perfect queen appears. The queen being hatched, the next important point is that she should be fertilised by a drone, and between April and July this appears to be a matter of no difficulty, but at other times the chance of fertilisation seems to be doubtful, and in any case, unless the queen be fertilised within thirty days of her birth, it would seem to be impossible, and under these circumstances any eggs she may lay will produce drones only. If she return impregnated, she usually begins the process of laying eggs in two days, and does not leave the hive until she accompanies a swarm and founds a new colony. We thus see that drone bees are produced from unfertilised eggs, worker bees from fertilised eggs, and that queens are simply specially developed workers. It is a debatable point whether drones from an unimpregnated queen can fertilise another queen. Drones may also be the progeny of fertile worker bees, which may be considered to be due to the larvæ having been fed for a time at least on the royal jelly, and so rather more developed. Further, the eggs which the queen bee lays in the drone cells become drones, though how this is brought about is not quite understood, but it is believed that the size of the aperture of the cell plays an important part in this way; the aperture of the drone cells being large, there is ample room for the body of the queen to be introduced without compression, and in this way the fluid from the spermathecæ is not pressed out, and thus non-fertile eggs are laid; whereas the openings of the worker cells being small, compression of the spermathecæ takes place, and fertilised eggs are deposited which become workers or queens, according to the way in which the larvæ are treated. The presence in a hive of fertile workers producing large numbers of drones is often a very great annoyance to the bee-keeper.

Combs. The combs are built by the bees of wax secreted in fine scales from between their abdominal rings. Comb building is generally carried on at night, or on days when the weather is such as to prevent the gathering of honey. They are hexagonal in form, and the sizes of those for drones and workers never vary; the first are about seventeen to the square inch, and the latter twenty-seven. In addition to their use for breeding, these cells serve for storing honey, but there are also proper honey cells, generally of the drone size, but very much deeper. Queen cells are only formed as required; they are of an elongated egg-shape, about one inch long and half an inch in diameter, and, contrary to the other cells

which have a slight upward tendency, these are always open at the bottom, that is, mouth downwards. Queen cells are never used twice. For a description of the process of construction of these cells and details as to the anatomical differences between the workers, drones, and queens, the reader is referred to 'The Apiary,' by Alfred Neighbour, and 'A Manual of Bee-keeping,' by John Hunter.

Bee-keeping. The object of bee-keeping for profit is to cause a given number of bees to produce the largest possible amount of honey and wax, and more especially honey; and it will be obvious from what has been said that, in order to do this, a maximum of workers and a minimum of drones should be produced, and that everything possible should be done to prevent the bees wasting their labour. Under the old system of bee-keeping, the bees were allowed to make their combs, according to their own plan, in a simple straw hive of the familiar form. So soon as this was full, in order to obtain the honey and wax it was necessary to destroy the bees, so that the hive having become full and a swarm having removed from it, and possibly having been lost to the owner, no means was left of increasing the stock, and consequently the profit of bee-keeping on this plan was little or nothing, the cost of a fresh stock being often greater than the value of the honey and wax obtained, this being generally dirty, and so mixed up with brood cells as to be hardly saleable.

Fig. 1.



Modern bee-keeping aims at the following objects:

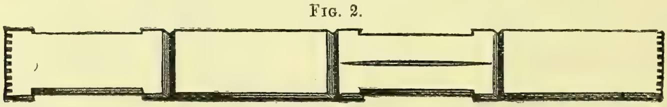
1. The prevention of natural swarming by the provision of ample accommodation for the bees.
2. The maintenance of the original breeding comb as long as possible without damage.
3. The removal of the honey without the destruction of the bees.

These objects are attained by adopting hives of special construction, by providing the bees with ready-made wax groundwork for the construction of their cells, and thus diverting a large amount of bee-labour from the manufacture of wax to the production of honey.

Fig. 1 shows Neighbour's 'improved cottage hive,' which is nothing more than an ordinary straw hive or skep, well made and with an upper story containing removeable frames, or sections as they are called (see fig. 2), in which the bees store the honey, the lower part being devoted to the breeding comb, and is not disturbed. As soon as these sections are full they are removed, and fresh ones put in their place. Contrivances having a similar object have been in use among cottagers for some time, *e.g.* an 'eke,' or additional stage added on to the straw hive below the original. These consist of rings of straw plait, and several of them may be used. When full the 'ekes' are severed from the main hive by a wire, but the honey in them is only fit for 'run honey,' as it will be contaminated with brood and bee-bread. A 'nadir' is another complete but empty hive with open feed-hole, placed below an over-full one where the bees have been hanging out. These should be cemented together at the junction, and the bees will then go down through the feed-hole, and fill the lower hive with combs, in which the queen will breed; the upper hive may at the end of the season be removed, and the combs cut out for 'run honey.'

These methods are all very clumsy and unsatisfactory when compared with the simple and perfect arrangements of 'frame hives,' such as those of Messrs. Geo. Neighbour, Messrs. Abbot Bros., and others. The principle of these hives is as follows: In the lower compartment of the hive are large frames suspended side by side, each frame carrying a sheet of stamped foundation (see fig. 3 and fig. 3 *a*), upon which the bees will build their combs: this is the breeding hive. Above this is placed one or more boxes communicating with the lower one, and which are filled with frames, or sections as they are called, in each of which a piece of 'thin foundation' is placed, and on this the bees build the cells in which the honey is stored. These boxes of sections are so arranged that when full they can be removed, and fresh ones put in their place without disturbing the bees, who, finding ample space, continue their labours and produce a further supply of honey. The general plan of one of these hives is well illustrated in fig. 4.

Fig. 2.



'Section' as sent out by the makers. It consists of a piece of thin wood with V-shaped cuts, so that it can be readily folded into a square of about $4\frac{1}{4}$ inches and secured by the dovetails at either end. The slit in one side is for the insertion of the piece of 'foundation.'

Fig. 3.

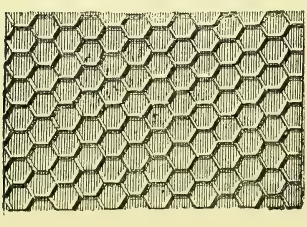
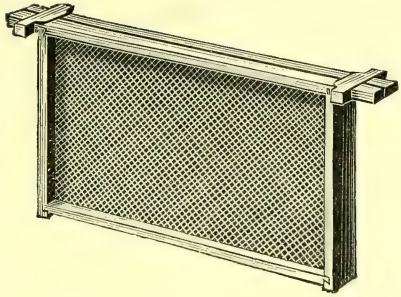
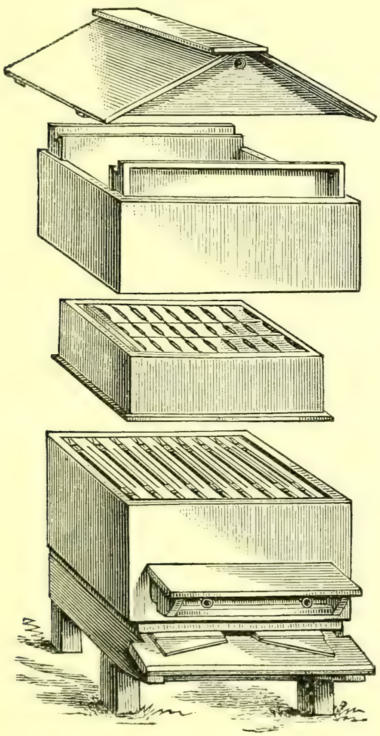


FIG. 3*a*.



'Section' for breeding-hive, with stamped foundation in place

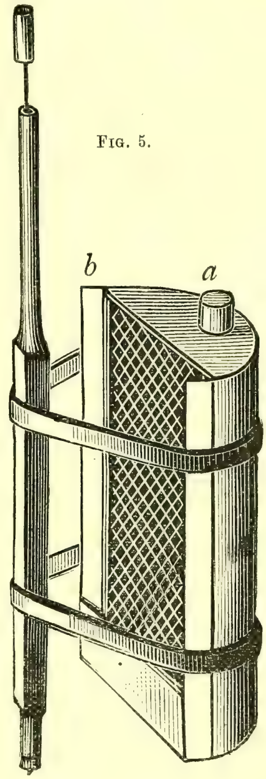
FIG. 4.



Neighbour's Sandringham hive.

The art of the modern bee-keeper does not end here. In order to still further save the bees from useless labour, the method of extracting the honey from the comb is such that the cells are injured as little as possible in the process. One of the sections is taken out of the super or upper box, as it is called, and the thin film of wax which seals the cells is removed with a suitable knife. The section is then placed in a centrifugal apparatus, and the honey is thrown out from the cells without damaging them further. The section can then be replaced in the super, and the bees will proceed to fill the cells again with honey. The time and labour of constructing fresh cells is thus saved. A simple apparatus for this purpose is shown in fig. 5.

FIG. 5.

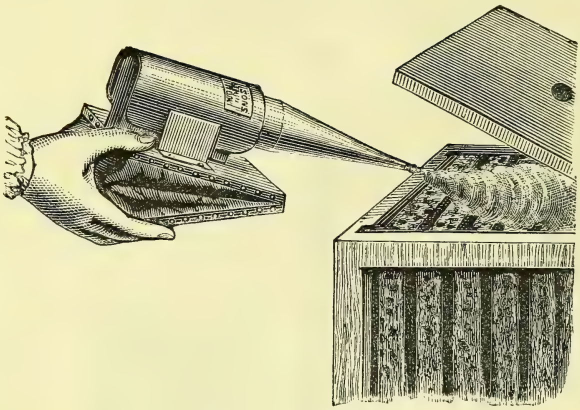


Abbott's Eccentric Extractor. The operator places the unsealed comb against the wire work in the can between *a* and *b*, and presses the short spike at the bottom into the floor. If he now grasp the loose handle with both hands and give them a slight circular motion the machine will begin to revolve, and with a little practice may be easily made to attain a speed of from 150 to 200 revolutions per minute, causing the liquid honey immediately to leave the cells and fly into the can, whence it may be poured at pleasure.

It will be evident that, by adopting this principle of hive construction, there is no necessity whatever for destroying the bees; all that is required is some simple means of quieting them when the supers are removed or the hive otherwise interfered with. This is easily effected by blowing the smoke of touch-wood, burning rag, or tinder into the hive by means of some such apparatus as that in fig. 6.

Amongst other appliances connected with bee-keeping QUEEN CAGES should be mentioned. These are of various forms, that figured being, perhaps, the simplest. They are little caps of wire gauze in which a new queen bee, *e.g.* a Ligurian, when it is desired to cross the breed, is placed; they are necessary because, unless protected in this way, the bees would in all probability kill the

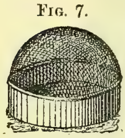
FIG. 6.



Neighbour's safety smoker.

stranger; but if time be given them they appear to accept her willingly (see figs. 7 and 8).

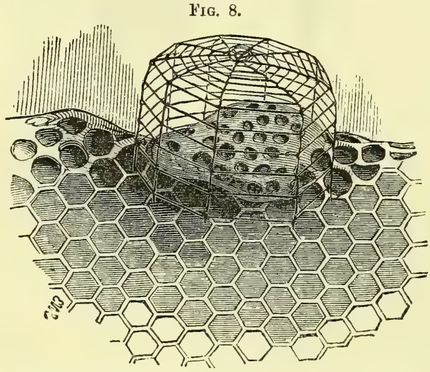
FIG. 7.



The simple Queen Cage. For enclosing a queen, by pressing it into the comb upon some open honey cells. Also useful for covering queen-cells.

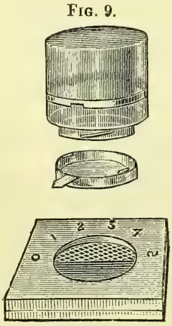
Feeding Bees. Bees require to be fed during the winter or

FIG. 8.



Mode of applying the queen cage from 'The Apiary.'

FIG. 9.



Abbott's specialty feeder.

in continued bad weather, otherwise they will consume their store of honey. The food should consist of strong syrup made of the best white sugar; an apparatus similar to the one in fig. 9 is in common use. Many other forms have been devised.

Abbott's specialty feeder. Consists of a glass jar specially made with ground edges covered with a tin cap. This is inverted on a wooden block, prepared to receive it. The tin top is pierced on one side only with five holes, but more may easily be made when very rapid feeding is desired. The wooden block contains a diaphragm, one half of which is composed of perforated zinc and the other of plain zinc. When the pierced side of the tin top is over the perforated side of the zinc diaphragm the bees have access to all the holes; but by simply turning the bottle round the supply of food may be reduced or cut off entirely, the index pin attached to the tin cap showing at a glance how many holes the bees have access to. The wooden block (or stage) should be set over the hole in the quilt.

Bee Diseases. Bees have not many diseases, but there is one known, as foul brood, which is peculiarly fatal and destructive. It consists in the death and putrefaction of the larvæ in their cells, by which they are converted into a disgusting semi-fluid, stinking mass, impossible for the workers to remove. It appears to result from exposure to cold and damp, and for this reason it is very desirable that hives should not be placed in exposed situations, and that they should be protected from the weather: a double casing filled with sawdust is very useful for this purpose. Foul brood is difficult if not impossible of cure; and, as it may be carried by the bees from one hive to another, perhaps the best plan is to destroy the hive and its contents. If the disease be at all serious removal of the affected portions is sometimes of use; and disinfectants, such as carbolic and salicylic acids, have been used. If it be desired to attempt to save the bees they must be driven out of the hive with the queen, and kept for twenty-four hours in a dark place. They are then transferred to a new hive and fed for two or three days on pure honey. In cold, damp hives dysentery will sometimes break out among the bees, and cause great destruction. As with animals, so with bees; in order to keep them in health they must be protected from cold and damp, and their hives and all pertaining to them must be kept scrupulously clean.

The following list of publications on bees and bee-keeping will be useful:

'Hive and Honey Bee' (American), by the Rev. L. L. Langstroth; Quinby's 'Bee-keeping' (American); 'Italian Alp Bee,' by Hermann; Hunter's 'Manual of Bee-keeping;' Cheshire's 'Bees and Bee-keeping,' vol. i, Scientific; vol. ii, Practical; Professor Cook's 'New Manual of the Apiary' (American), new edition; Newman's 'Bee Culture;' Root's 'A B C of Bee Culture;' 'Rational Bee-keeping,' Dzierzon; 'British Bee-keepers' Guide-book,' by J. W. Cowan, Esq.; 'Heddon's 'Success in Bee-keeping;' 'Modern Bee-keeping,' published by British Bee Association; 'Bee-keeper's Handy Book,' Alley; 'Bee-keeping, Plain, Practical,' Rushbridge; 'Bee Pasturage,' H. Dobbie; 'The Method of Direct Introduction,' Simmins; 'A

Modern Bee Farm and its Economic Management,' by S. Simmins; 'Original Non-Swarming System,' Simmins; 'Essay on Bees,' Thompson, known as the Lanarkshire Bee-keeper; 'A Book about Bees,' Jenyns.

BEES'WING. The second or pseudo-crust so much admired in port and a few other wines, and which forms in them only when kept for some time after the first or true crust has formed. It consists of minute, glittering, floating particles or lamellæ of cream of tartar, purer and freer from astringent matter than that deposited in the first crust. See CRUST, WINES, &c.

BEET (bēte). *Syn.* BE'TA, L.; BIET, D.; BETTE, Fr.; BEETE, MANGOLD, M.-KRAUT, Ger.; BIETOLA, It. The common name of plants of the genus *Beta* and the Nat. Ord. CHENOPODEÆ (DC.). There are said to be only two distinct species cultivated—*Beta vulgăr'is* and *B. horten'sis*—each of which occurs in several varieties; those of the first, and which we have chiefly to consider, producing a large fleshy root (BEET'ROOT, MANGOLD-R.; RA'DIX BE'TÆ, L.; BETTERAVE, Fr.; ROTHE RÜBE, &c., Ger.), which is both sweet and succulent; those of the other, only succulent leaves. The varieties most useful, and now the most extensively cultivated in England, are of comparatively recent introduction; field beet, the mangel-wurzel of the Germans, having been only brought under the notice of our agriculturists towards the end of the last century.

Beet, Field. See BEET, HYBRID (*below*).

Beet, Hy'brid. *Syn.* COMMON BEET, FIELD B.; BE'TA HY'BRIDA, B. VULGAR''IS H., L; BETTE COMMUNE, BETTERAVE C., RACINE D'ABONDANCE, R. DE DISETTE, &c., Fr.; MANGOLD, M.-WURZEL, MANGEL-W., &c., Ger. A variety of *Beta vulgaris*, Linn., and that usually cultivated by English farmers. Root red on the outside, white inside; chiefly grown as winter food for cattle, being vastly superior to turnips. It has been used in Germany as a substitute for bread in times of scarcity. Leaves dressed and eaten like spinach.

Beet, Red. *Syn.* CU'LINARY BEET, GARDEN B., BEET'-RADISH, BEET'-RAVE, &c.; BE'TA RU'BRA, B. VULGA''RIS R., L.; BETTERAVE, &c., Fr.; ROTHE RÜBE, &c., Ger. Root tender, well-flavoured, and of a rich red colour throughout, and hence much used in salads, pickles, and cookery; also made into a conserve, jam, or confection. The kinds most esteemed for salads are the small red and the yellowish-red varieties of Castelnaudari.

Beet, Sea-. *Syn.* BE'TA MARIT'IMA, L. Said to be the best variety for dressing as spinach.

Beet, White. *Syn.* BE'TA AL'BA, B. VULGA''RIS A., B. CI'CLA, L.; BETTE BLANCHE, POIRÉE, &c., Fr. A sub-variety of the red beet. Root white, and hence preferred for making sugar, that with a purple crown being the most esteemed.

Obs. The preceding varieties of beet resemble each other in their general properties. They are all antiscorbutic, detergent, emollient, and nutritious; and their roots contain about 8% of sugar, which, by proper treatment, may be obtained from them of excellent quality; 100 lbs. of root yield on an average 7 lbs. of sugar. The grated root is sometimes used to dress blisters and foul ulcers. When sliced and dried in a malt-kiln, a very palatable beer may be brewed with it. The leaves of each variety are dressed and eaten like spinach. The roots, for the table, after being carefully washed, are dressed whole—neither scraped nor cut—and, according to their size and age, require from 1 to 4 hours' simmering or baking. They are mostly served in slices, cold, intermingled with other winter salad vegetables. See BREWING, CATTLE, SALADS, SUGAR, &c. (also *antè*).

BEETLE (bētl). *Syn.* SCAR'AB†*, SCAR'ABEE†* (-bē); SCARABÆ'US, L.; ESCARBOT, SCARABÉE, Fr.; KÄFER, Ger.; BETEL, Sax. In *zoology*, the common name of an extensive genus of insects (*Scarabæ'us*, Linn.), of numerous species. It is also popularly applied to all coleopterous insects, or such as have hard or shelly wing-cases, especially to those of a dark or obscure colour. The common pests of our kitchens and basement floors which pass familiarly under the name of beetles, black-beetles, or cockroaches, belong to the ORTHOPTERA, and not to the COLEOPTERA or beetle tribe, as the name implies. See INSECTS, &c.

Black-beetle; Domes'tic beetle. See BLATTA, COCKROACH, &c.

Blis'tering Beetle. See CANTHARIDES.

BEETROOT. See BEET.

BELL. *Syn.* CAMPA'NA (appropriately, a large bell suspended or adapted for suspension, as that of a church, &c.), CAMPAN'ULA (a small bell), NO'LA* (*id.*), TINTINNAB'ULUM (*id.; appr.*, one suspended as a door-bell, servants' bell, &c.), L.; CLOCHE, CLOCHETTE (a little bell, a hand-bell), GRELOT (a little round bell), Fr.; GLOCKE, SCHELLE, &c., Ger.; BELL, BELLA, BELLE, Sax A hollow vessel or body, usually of cast metal, with a wide cup-like mouth expanding outwards, so formed as to emit sound when suspended and struck with a hard substance. The word is also applied, either alone or in composition, to substances having the figure of a bell; as bells (of flowers), bell-animal, b.-flower, b.-glass, &c.

Form, Manuf., &c. Bells of "the common and well-known shape, with a thick lip or sound-bow, are the most effective known instruments for producing a loud and musical sound, such as you want when you erect a large public clock, or put up a peal of church bells . . . . After trying a number of experiments at Messrs Warner's, I am quite satisfied that there is nothing to be gained by deviating materially from the established proportions of the best old bells" (lecture on the 'Form of Bells,' delivered at the Royal Institution by Mr B. Dennison, to whom the Government entrusted the construction of the 'great bells' for the New Houses of Parliament). This view is borne out by the researches of the Government Commissioners (Prof. Wheatstone and Sir Charles Barry), who visited the Paris Exhibition, who report that, among the 'founders' of France and Belgium, there are no traditions of the art, nor any discoveries or appliances of modern science tending to the improvement of bells, or to provide efficient substitutes for them; nor is there any known improvement on the established mode and usual material (BRONZE or BELL-METAL)

for casting them. Sir C. Barry, indeed, according to Mr Dennison, "seemed rather impressed with the merits of cast-steel bells;" but both Prof. Wheatstone and Mr Dennison differ from him in opinion. Undoubtedly some cast-steel bells, of small size, have been produced, capable of yielding sounds of extraordinary clearness and richness; but, in most cases, owing to the difficulty in giving the peculiar molecular condition to the metal essential to a high degree of sonorousness, their tones are comparatively harsh and disagreeable. Well-annealed glass offers a cheaper and better material than steel for large bells up to a certain size, whilst its tones are exquisite. As the depth of the tone of a bell depends chiefly upon the dimensions and weight of the sound-bow, it appears likely that, by directing our experiments to the increase of these, and the diminishing of the thickness of the metal in the other parts, the quantity of metal required to produce large bells might be very greatly reduced. The sound of an Indian gong that may be easily held suspended by the hand is always rich, and usually as loud and deep as a bell of ordinary construction which it would take several men to lift. The Chinese often use bells made of porcelain. Small hand-bells for the toilet and boudoir are often made of silver, and then yield tones which are remarkably soft, clear, and pleasing. The tongue, clapper, or hammer of bronze bells should be of iron; and of steel bells, of bronze. Glass and porcelain bells require the striking part of the tongue to be of box-wood, the proper weight being given by a ball of iron cast on the rod immediately above it, and a similar one screwed on the end of the rod immediately below it. In all cases the hammer-head, preferably globular, should strike the bell near the verge, and should be free from projections or asperities.

The casting, &c., of bells is essentially similar to that of other articles in bronze of corresponding size, and particularly of cannon. See BELL-METAL, BRONZE, &c.

BELLADON'NA (-dŏn'-ă). [It., Sp., Port.; Eng., L., Ger. (as a borrowed word), B. P.] *Syn.* DEAD'LY NIGHT'SHADE, DWALE; BELLEDAME, BELLADONNE, &c., Fr.; TÖDTLICHER NACHTSCHATTEN, TOLLKERSCHE, TOLLKRAUT, WOLFSKIRSCHE, &c., Ger.; AT'ROPA LETHA'LIS*, SOLA'NUM FURIO'SUM*, S. LETHA'LE*, S. MANI'ACUM*, S. MELANOCER'ASUS†, &c., L., Bot. var. Literally, fair lady; in *materia medica, botany*, &c., the usual name (adopted from the Ital.) of *At'ropa belladonn'a*, Linn., an indigenous, poisonous, perennial, herbaceous plant, of the Nat. Ord. SOLANÆ, DC. (SOLANACEÆ, Endl., Lind.). It flowers in June and July, and its drooping purple blossoms are ornaments of our hedges and wastes where the soil is calcareous. It is supposed to be the 'insane root' of Shakespeare ('Macbeth,' act i, sc. 3).

The parts of this plant used in medicine and pharmacy are the "fresh leaves and branches to which they are attached; also the leaves separate from the branches, carefully dried, of *Atropa belladonna;* gathered, when the fruit has begun to form, from wild or cultivated plants in Britain" (B. P.). The plant is cultivated at Hitchin and Market Deeping. It was supposed that the wild was more active than the cultivated plant. Gerrard says there is but little difference.

Prop., Uses, &c. Every part of this plant contains ATROPINE and HYOSCYAMINE, and is consequently highly poisonous. Every part, except the berries, is fœtid when bruised, and of "a dark and lurid aspect, indicative of its deadly narcotic quality ('Pereira,' 4th ed., vol. ii, 545). Its berries, which are of a glossy violet-black, and of the size of a small cherry, are sweet-tasted, and not at all nauseous. Children and tired travellers and soldiers, allured by their beauty and the absence of disagreeable flavour, have frequently been induced to eat them; but in all cases poisoning, often fatal, has followed the indulgence. One hundred and fifty French soldiers were thus poisoned at Pirna, near Dresden (*Orfila*, 'Tox. Gén.'). Belladonna is in qualified hands a most valuable medicine. Its chief use is as an anodyne, antispasmodic, sedative, and discutient, and particularly to diminish sensibility and allay pain and nervous irritation in a variety of diseases—neuralgia, arthritic and migratory rheumatic pains, painful ulcers, cancer, spasmodic rigidity, strictures and contractions (especially of the bladder and uterus), angina pectoris, iritis, epilepsy, chorea, hooping-cough, hysteria, mania, fevers, phthisis, asthma. It further acts as a typical mydriatic; dropped in the eye it powerfully dilates the pupil; it is a marked anti-sialogogue, gastric sedative, and aperient. It diminishes most secretions and is a prominent anhydrotic and anti-galactagogue. The effects of the drug need watching. Its administration should be checked when dryness of the mouth and throat set in, and the pupils become dilated. It often produces a scarlatina-like rash, whether taken internally or applied externally. It is employed both internally and externally, in various forms, as noticed under its 'preparations' elsewhere.—*Dose.* Of the powder, ½ to 1 gr. twice a day, gradually and cautiously increased until dryness of the throat or dilation of the pupil occurs, or the head is affected.

Pois., &c. Belladonna and its preparations are poisonous to *all* animals, but very much more so to the carnivora than to the herbivora. It also acts as a poison on vegetables.

Treatm., Ant., &c. These may be the same as those employed in poisoning by aconite, atropia, and opium. The stomach must be cleared as soon as possible, followed by active purgation. Emetics as a tablespoonful of mustard, or 20 gr. of sulphate of zinc, in warm water. If copious vomiting does not rapidly follow, the stomach-pump may be had recourse to. When the poison has been removed from the stomach, copious and continued draughts of astringent vegetable solutions (weak decoction of galls or oak bark, or strong coffee or green tea), should be persisted in for some time; followed by like draughts of water soured with any mild vegetable acid (as vinegar, lemon-juice, citric or tartaric acid, &c. Half a grain of nitrate of pilocarpine may be given hypodermically.—*Detec.* The contents of the stomach or vomited matter may be searched for the berries, leaves, seed, or portions of the

root; all of which are easily recognisable. The usual physiological and chemical tests of atropia may also be applied to these and to the organic liquids supposed to contain the poison. See ALKALOID, ATROPIA, EXTRACTS, OINTMENTS, TINCTURES, VEGETABLE JUICES, &c.

BELLADONNINE. *Syn.* ATROPIA, which *see.*

BELLA SOMBRA. Nat. Ord. PHYTOLACCACEÆ; *Phytolacca dioica*, L. An umbrageous tree of South America, introduced into Spain, where it is planted as a shelter in public promenades.

BELLITE. The composition of this new explosive is made known by M. Lamm, who tells us it contains nitrate of ammonia 4 or 5 parts by weight, and dinitro benzene 1 part. The powder is yellowish, and feels almost dry. It is fired for blasting or other purposes by means of a small quantity of fulminate of mercury. It is said that it can be safely transported and stored, as it is not exploded by a blow or by friction. Its strength is 2 or 3 times that of ordinary black gunpowder.

BELL'-METAL. *Syn.* AES CAMPANA″RUM, L.; MÉTAL DE CLOCHE, Fr.; GLOCKENGUT, GLOCKENSPEISE, Gr. The variety of bronze from which bells, &c., are made. The chief requisite of good bell-metal is that it shall give a pure full sound, and the alloy must possess great homogeneity and hardness, and considerable strength; these properties are afforded by an alloy containing 78 to 80 parts of copper and 22 to 20 parts of tin. The colour of good bell-metal when recently cast is a peculiar greyish-white, different from that of ordnance or statuary bronze. The appearance of its fracture indicates to some extent the composition of the metal; if the fracture is too fine, the alloy contains too much tin; if it is too coarse-grained it contains too little. The casting of bell-metal is similar to that of bronze (which *see*). Some makers add only two-thirds of the tin at first, and the remaining third when this has thoroughly mixed with the copper. Large bells are cast in loam moulds, small bells in moulds of sand or iron. Bell-metal is brittle, and cracks under the hammer when cold, as well as when hot. The tone of a bell depends on its shape, and on the quality of the metal; a large proportion of copper gives a deep tone, while iron, tin, and zinc make the tone sharper. Bismuth, lead, and antimony are also often added, but all these additions render the metal more crystalline and brittle, and injure its sonorousness. The presence of silver was once said to increase the sonorous character of a bell, but this is no longer thought to be the case. To get the maximum of sonorousness the 'pieces' should be raised to a cherry-red heat, and cooled quickly by being plunged into water; they can then be hammered to their proper form, and this being done they should be again heated, and allowed to cool slowly. The Chinese tam-tams, or gongs, owe their far-reaching sound to this method of treatment. Large bells have usually much about the same composition, but they are never quite homogeneous; small bells are exceedingly variable in composition, some consisting merely of tin with a little copper or antimony. The composition of some varieties of bell-metal is given below:

Large Bells.

	PARTS.					
	Copper.	Tin.	Zinc.	Lead.	Silver.	Iron.
Normal composition	78 to 80	22 to 20	—	—	—	—
Alarm bell, Rouen	76·1	22·3	1·6	—	1·6	—
„ Ziegenhain	74·8	33·59	—	4·04	—	0·12
„ Darmstadt	73·94	21·67	—	1·19	0·17	—
„ Reichenhalt (13th cent.)	80	20	—	—	—	—
Tamtam	78·51	10·27	—	0·52	0·18	—
Japanese bells	10	4	1·5	—	0·5	—
„ „	10	2·5	0 5	1·33	—	—
„ „	10	3	1	2	0·5	—
„ „	10	—	—	—	—	—

Small Bells.

	PARTS.						
	Copper.	Tin.	Zinc.	Lead.	Silver.	Antimony.	Bismuth.
House bells	80	20	—	—	—	—	—
„ smaller	75	25	—	—	—	—	—
Clock bells, German	73	24·3	2·7	—	—	—	—
„ Swiss	74·5	25	—	0·5	—	—	—
„ Paris	72	26·56	—	—	1·44	—	—
Sleigh bells	84·5	15·42	—	—	—	0·1	—
White table bells	17	800	—	—	—	—	5
„ „	—	7	—	—	—	1	—
Silver bell-metal	40–41·5	60–58·5	—	—	—	—	—

BELL'Y (-e). The abdomen (which *see*).

BELTS. In their connection with health and disease, see BANDAGE, DRESS, STAYS, &c.

BENEDICTINE'S HEALING-PLASTER (*Hauber*). 35 grms. of a dark brown plaster, prepared by digesting together 1 part litharge with 2 parts olive oil until they become blackish-brown, then adding 4 parts yellow wax, containing the heat for a short time, and then pouring out (*Wittstein*).

BENGAL' (-gawl'). A thin fabric of silk and hair interwoven, originally from Bengal.

Ben'gal Light. A firework used as signals. See FIRES (coloured).

Ben'gal Stripes. Cotton cloth, woven with coloured stripes, orig. from Bengal; gingham.

BENZ-ANILIDE. This compound is analogous in constitution to acetanilide (antifebrin); acetanilide being formed by the action of acetic acid on aniline, benz-anilide by the action of benzoic acid on aniline, or better, by the action of benzoyl chloride on aniline. It is a white, crystalline powder, insoluble in water. Dr Kahn ('Apotheker Zeitung') found, from experiments made with this substance, that this was a powerful antipyretic, and seems to have given good results, especially in the treatment of children. In some ways he considers it superior to antifebrin. The reported dose varies from 3 to 10 gr.

BENZENE, C_6H_6. *Syn.* BENZOL (*Note.* The termination -ol in *chemistry* is now confined to certain compounds which contain the group (OH) such as glycerol, phenol, &c.), HYDRIDE OF PHENYL, &c.; BENZO'LEUM, L.; BENZINE, Fr.; BENZOL, Ger.

This hydrocarbon was first isolated in 1825 by Faraday, who obtained it together with butylene from the oil left from portable gas, an illuminant at that time manufactured by strongly heating fats and oils, and compressing the evolved gas into metallic reservoirs. Faraday named the compound bicarburet of hydrogen, C_2H ($C = 6$).

Subsequently Mitscherlich obtained it in 1834 by distilling benzoic acid with lime, and suggested that it was derived from the former by the removal of carbonic anhydride. It is not certain who discovered the presence of benzene in coal-tar. It may be mentioned that coal was distilled at a date prior to its use for the manufacture of gas, the distillation being carried out for the sake of the naphtha, which was employed to dissolve the residual pitch for the manufacture of black varnish.

Benzene was prepared in quantity in 1848 by Mansfield, who proved that coal-tar naphtha contained homologues of benzene.

Sources. Benzene occurs in the more volatile portion of coal-tar, a product obtained in the distillation of coal for the manufacture of illuminating gas, or of coke for metallurgical purposes. It also occurs in the products of the destructive distillation of wood and of many organic compounds. Aromatic acids, such as benzoic or phthalic acids, which are derived from benzene by the substitution of hydrogen by the group (COOH'), are decomposed when distilled with lime, yielding benzene, thus:

$$C_6H_5.COOH = C_6H_6 + CO_2.$$

Benzene is formed when the vapours of many organic compounds are passed through a red-hot tube. In this way simple substances, such as marsh gas, alcohol, &c., 'condense' to form benzene. This is particularly the case with acetylene, three molecules of the gas combining to form one of benzene:

$$3C_2H_2 = C_6H_6.$$

Manufacture. Benzene occurs mainly in the more volatile portion of coal-tar. The crude tar of the gas-works is first submitted to a rough fractionation, by which it is separated into the following portions:

1. First runnings, up to 105° or 110° C.
2. Light oil, up to 210° C.
3. Carbolic oil (for phenol and naphthalene), up to 240° C.
4. Creosote oil, up to 270° C.
5. Anthracene oil, above 270° C.

The first contains the greater portion of the benzene, together with water, methane homologues, thiophene, olefines, carbon bisulphide, mercaptans and nitriles, together with small quantities of high-boiling products, viz. phenols, naphthalene, and aniline and other bases.

The second fraction contains less benzene, with toluene and higher homologues of aniline, and some carbolic acid.

The third fraction contains carbolic acid, naphthalene, and small quantities of benzene and its homologues.

The points at which the various fractions are collected vary at different works. The light-oil fraction is usually collected when the distillate sinks in water. When this is the case, the whole distillate, after being rendered homogeneous by mixing, will have a sp. gr. of 0·975. When tested by distillation (see *below*), it should begin to boil at 95° C., the bulb of the thermometer dipping into the liquid. Very little, however, should come over below 120° C., but more than 30% between 120° and 171° C. In order to get a correct idea of the value in benzene of the light oil, the portion coming over at 120°—171° C. should be redistilled (see *below,* under *Retort test*).

The first operation in the preparation of commercial benzene and its homologues consists in redistilling the light oil and dividing it into three fractions, viz. (1) 'light-oil naphtha' or 'twice-run naphtha,' the portion which comes over first and which is mixed with the first runnings of the original distillation; (2) a middle portion, boiling between the same limits of temperature as the original light oil (this is nearly always mixed with fresh light oil and redistilled); and (3) the residue left in the retort after the middle portion has passed over (this last is added to the carbolic oil of the original distillation, the mixture being treated with soda for carbolic acid). The oils left after treating carbolic oil with caustic soda are worked up in the same way as the light oil, the first two fractions being mixed with the corresponding ones from light oil. It will thus be seen that the whole of the benzene is obtained from the first three fractions of the original coal-tar distillation, and that the effect of the first rectification is to suppress the middle fraction, the first runnings and carbolic oil alone remaining. It is with the first that we have to deal for the manufacture of the various forms of benzene and naphtha.

In the distillation of light oil the collection of the second fraction is usually commenced when the distillate shows 10° under proof by Sykes's hydrometer (0·932 sp. gr.), and is continued until it has sufficient density to sink when poured into water. It is known as 'secondary light oil,' and is sometimes chemically treated (see *below*) and used as solvent naphtha; more frequently, however, it is redistilled with fresh light oil, as already stated.

The rectification of light oil is usually carried out in iron stills heated by direct fire, and pro-

vided with man-hole, safety-valve, discharge-pipe, and condensing worm, the latter being preferably placed outside the building. The condenser must be well supplied with water so long as naphtha comes over, but must be allowed to become warm towards the end of the operation, otherwise there is danger of the tube becoming choked. For the same reason the worm should present a gradual fall through the whole of its course, so that the distillate may drain away completely.

First Runnings. These, as we have seen, consist of the first fraction from the crude coal-tar and of that from the redistillation of light oil. They contain the whole of the benzene of the coal-tar, together with a great number of the more volatile constituents. Good first runnings, when distilled (see *below*), should yield at least 10% by volume of the sample taken below 110° C., and 78% below 171° C. On redistilling the portion which came over below 130° C., at least 25% of it should distil over below 100° C. The following table gives the average of a large number of samples :

Sp. gr.	100°	110°	120°	140°	170°	200°
0·905	2	14	33	57	80	92.

Before any further rectification of the first runnings or crude benzene is attempted, the product is always submitted to a chemical purification, which consists of (1) treatment with strong sulphuric acid, and (2) treatment with caustic soda solution. The sulphuric acid combines with bases, dissolves thiophene and its homologues, destroys resinous bodies, and dissolves olefines, &c. The soda removes phenol by combining with it to form soluble sodium phenate. It also removes any sulphonic acids or sulphuric acid left behind in the first treatment.

Of these two operations the treatment with sulphuric acid is by far the most important, owing to the large number of impurities which are removed by its means. Formerly it was usual to begin with the acid, but now treatment with soda frequently precedes the use of the latter. The object of this change is to allow of the recovery of the phenol which is removed by the soda, and which would be too impure if the soda treatment succeeded that with sulphuric acid, owing to the sulphonic acids, &c., which would be removed along with it. This mode of operating is obviously of considerable value where the separation of first runnings is dispensed with; and even with the latter fraction it is advantageous, since the carbolic acid obtained is of the purest description. It should be mentioned that a final treatment with soda is always necessary in order to remove traces of sulphuric acid, but if the phenols have been already taken out, the soda solution may be very dilute.

Various forms of apparatus are used for treating crude naphtha with acid and alkali, the two essential conditions being that the acid and benzene should be continuously and thoroughly stirred together, and that, after the liquids have been allowed to come to rest and separate from one another, it should be possible to drain off each liquid quite free from the other. This is effected by making the bottom of the vessel funnel-shaped and terminating in a tap. The agitation is effected by means of paddles, rotating archimedean screws, or by other similar appliances. It is found that metal can be used for these apparatus, since the tar with which the acid soon becomes charged considerably reduces the action of the latter. Where the mixing is done by hand, perforated wooden rakes are employed, by which the acid is continually lifted up from the bottom. The acid used is the strongest acid of trade (sp. gr. 1·84). Since the action of sulphuric acid on benzene itself is not inappreciable, care should be taken not to use a larger quantity than is necessary. Lunge ('Coal-tar and Ammonia') finds that the action of sulphuric acid is greater with the higher homologues of benzene than with benzene itself. The quantity of acid required varies somewhat, but not very much, the usual amount being 1 lb. of acid to a gallon of oil (first runnings or light-oil naphtha), that is, 12 parts of acid to 100 parts of naphtha by weight. If more than this is added, loss of oil is apt to ensue; while if less is used, the oils become discoloured on standing. Freshly distilled oils require less acid than old ones, as the latter always contain empyreumatic resins. Since the quantity of acid is so chosen that it may have as little action as possible on the benzene, toluene, &c., it follows that commercial benzene will always contain impurities such as thiophene or pyridine, which are only slightly attacked. A larger quantity of acid must be used if these impurities are to be removed (see *below*).

Before running in the acid the naphtha is left at rest in the vessel for some time, so that admixed water, which is always present, may settle to the bottom. This is removed before adding the acid, which would otherwise become diluted. The acid is now run in and the mixing apparatus set in motion. Fifteen minutes' agitation is sufficient where mechanical appliances are used. The liquid is then allowed to come to rest, so that the dirty acid and benzene may separate. For this at least an hour should be allowed, and a longer time is advantageous. The acid should not, however, be left at rest for too long a time, otherwise it may become so thick that it will be found impossible to separate it. The appearance of the acid will give a useful indication of the character of the crude benzene and of the success of the operation. If it is very thick, this is a sign that an insufficient quantity has been used to remove and dissolve the impurities of the naphtha. An abnormal amount of the latter may have its origin in careless distillation, resulting in a boiling over of the contents of the still. If the acid is very thin, it is a sign that too much has been used, or that it has become unduly diluted by the admixed water of the naphtha, and so has failed to perform its office. The acid after mixing should have a volume about double that of the original acid taken.

When the separation of the benzene and acid is complete, the latter is run off by means of the tap at the bottom of the apparatus. This must be effected to the last drop, since any acid left behind, on being diluted in the next operation, will deposit the impurities which it holds in solution, and so will contaminate the naphtha to a worse extent than before. The dirty acid should not be run into the common sewer, but should be

collected in carboys or discharged direct into the main sewer or into a river (for use of acid-tar, see AMMONIUM SULPHATE MANUFACTURE). In order to avoid the production of an emulsion of tar when the residual acid is diluted in the washing with water, it is sometimes usual to wash the benzene once or twice with a small quantity of fresh strong acid, which is removed as before. The naphtha is next washed with water in order to remove acid. For this purpose a quantity of water equal to 1-5th the volume of the naphtha is run in, and the agitator set in motion. This is continued for a quarter of an hour, and is followed by an interval of rest of one hour, during which the water gradually settles. The latter is then run out as completely as possible, and a second quantity of water added, the operation being repeated four or five times. The water acquires at first a deep ruby colour, but the last wash-water should be colourless. As it is difficult to remove the water completely without letting out some of the benzene at the same time, it is usual to allow it to run first into a catch-pool placed in the middle of the floor of the house, and provided with an outlet at the bottom, through which the water gradually escapes, any benzene which has come along with it remaining on the surface, from which it is removed from time to time.

The treatment with alkali now follows. This alkali has a sp. gr. of 1·100. The quantity used varies from $1\frac{1}{2}$ to 6 vols. of alkali solution to 100 vols. of tar-oil. The amount which is necessary is easily determined by watching the colour of the naphtha, the alkali being run in, with agitation, until it changes from reddish-brown to light brown or brownish-yellow. The change takes place very abruptly. The liquids are now well mixed up and then left for an hour to separate. The alkali is run off, and the naphtha, after two washings with water, is ready for distillation. When the treatment with alkali precedes that with sulphuric acid, it is usual to employ a stronger alkali (sp. gr. 1·15). In this case less acid will be required, and also much less alkali in the final treatment, which must never be omitted.

The loss in the chemical treatment of first runnings and light oil varies from 4% to 12%, and is generally about 8% by volume. The naphtha, purified as above, is now either at once distilled with steam, or submitted to a first fractionation over direct fire in what is known as the benzene still. The latter course is the best, since, if this be omitted, the naphtha is apt to discolour after a time. The distillation is exactly similar to that of crude light oil, already described. The different fractions are run into iron tanks entirely closed in, with the exception of an orifice into which the end of the condensing worm is inserted. At first the worm must be kept quite cold by a plentiful supply of water, but towards the end of the distillation the latter may be allowed to become tepid. The distillation is controlled by the thermometer, the receiver being changed when the temperature of the vapour reaches a certain point. As this necessitates that the attendant should be pretty reliable, another plan is to distil a small amount of the oil and note what volumes come over at the required temperatures. All that is then necessary is to know the quantity of oil run into the still and the capacity of the receivers, when the number of inches of liquid which must be distilled into each receiver can be calculated.

The temperature at which the receivers are changed varies according to the quality of naphtha required. For 90% benzene the first fraction consists of all coming over below 110° C. (230° F.), the second of that which comes over between 110° and 140° C., the third of that obtained between 140° and 170° C. For 50% benzene only two fractions are made, viz. below 140° C., and from 140° to 170° C. The distillation is not carried beyond 170° C., as the product boiling above this temperature would injure the quality of the naphtha derived from the second fraction. The residue in the still is worked up with light oil.

The next operation consists in distilling the various fractions already obtained by steam heat, or by passing steam directly through the naphtha. The apparatus in its best form consists of a sheet-iron still, the body of which is filled with a wrought-iron worm conveying steam at 2·5 to 3 atmospheres pressure. In addition to this a perforated steam-pipe opening into the still is provided, so that when the distillate begins to decrease, the distillation may be assisted by a current of steam passing through the liquid. The vapours from the still can be made either to pass directly to the condensing worm or first through a dephlegmator, the path being determined by the opening or closing of certain taps suitably placed. The dephlegmator consists of a number of vertical tubes opening into chambers above and below, through which the mixed vapours are caused to pass. The tubes and chambers are immersed in water, which can be kept at a suitable temperature by means of steam-pipes. It will be seen that if the dephlegmator be kept at a suitable temperature, the less volatile constituents will condense and will collect in the lower chamber, from which they drain back into the still by a pipe provided for that purpose, whilst the more volatile constituents will pass on and will be liquefied by the more thorough cooling which they experience in the condenser. The condensed liquid then passes through a small tank where the naphtha separates from the water with which it is mixed, the outlets being so arranged that the lower layer of water and upper layer of naphtha drain away continuously through different pipes. The naphtha is led into a solution of caustic soda, on the top of which it collects, and then drains away into reservoirs suitably disposed to receive the different fractions. The means by which the different fractions are controlled are very varied, differing according to the stage of the distillation at which direct steam is introduced, and also with the temperature at which the dephlegmator is maintained. Steam is never introduced, when distilling benzene, until the more volatile products have passed over by means of heat alone, since the well-known effect of a current of steam in assisting the distillation of high-boiling liquids would make the first fractions much less pure than if they were distilled by heat

alone. The higher fractions obtained from the benzene still are distilled at once with steam. The usual object in the rectification of naphtha is to obtain 'benzol' of certain specific qualities rather than to effect a complete separation of the constituents, and it is obviously advantageous to do this with as few distillations as possible. For 90% 'benzol' the water surrounding the dephlegmator is kept at about 60° C. (140° F.), and for 50% 'benzol' at 70°—80° C. (158—176° F.). The necessary temperatures vary somewhat with different apparatus, and can only be found by experience. When nothing further comes over, the temperature is again raised if 30% or 40% benzene is required. Lastly, toluene, if required free from higher homologues, is driven through the dephlegmator by raising the water surrounding it to the boiling point, the still being heated by indirect steam. The dephlegmator is now cut out and steam introduced into the still, when solvent or burning naphthas are obtained, according to the temperature at which the distillation is arrested.

Although the production of the various trade varieties of 'benzol' can be effected by a proper adjustment of the temperature of the dephlegmator, it is usual to check the result and determine the point at which the receiver should be changed by a laboratory determination (see *below*). (The term 'benzol' is used here for the commercial product, and the term 'benzene' for the pure substance.) For instance, if 90% 'benzol' is required, a sample is taken from the distillate, after thorough mixing, just before the time at which it is considered the receiver should be changed. If the analysis shows 90% benzol, the receiver is changed at once, since the latter part of the distillate contains the least benzene, and the proportion of this would therefore rapidly decrease. It is usual, however, to store the benzene whilst somewhat too strong, and then dilute it with some of the subsequent distillates. The necessary calculation is effected as follows:—Supposing the first distillate to consist of 120 gallons of 95% benzol, and the second of 160 gallons of 75% benzol, and supposing x to be the amount of the second which must be added to the first in order to convert it into 90% 'benzol,' then

$$(120 \times 95) + (x \times 75) = (120 + x)90$$

whence $x = 40$.

The remaining 120 gallons of 75% 'benzol' may now be pumped, say, into the 50% reservoir, and a similar calculation will tell us how much of the third distillate (consisting of 40% 'benzol,' for instance) must be added in order to convert it into 50% 'benzol.' On account of the above calculations, the amounts and the composition of the different distillates should be carefully recorded, so that they may afterwards be mixed according to trade requirements.

The 40% or 30% 'benzol' of commerce is mainly toluene, and is sometimes sold under this name. It should yield 90% at 120°. The fraction succeeding 'benzol' is sometimes used for carburetting gases (see COAL GAS), and is known as carburetting naphtha. It should yield 70% at 130° C., and 90% at 150° C. Its sp. gr. should be 0·85—0·87. If the above fraction is not collected, the distillate succeeding 'toluene' is divided into solvent and burning naphthas. The former consists mainly of xylenes and trimethylbenzenes, and is largely used as a solvent for india-rubber in the manufacture of waterproof fabrics and for removing grease stains. It should not contain naphthalene, hence the distillation should not be carried too far. It may be arrested when the liquid issuing from the condenser has a sp. gr. of ·880 at 15° C. (59° F.). The whole distillate, when mixed, will then yield 90% at 150° C., and have a sp. gr. of 0·875. That which comes over above this is used for burning, and the distillation is continued until the distillate begins to have a slight colour, or until the naphtha issuing from the worm attains to a sp. gr. of 0·900 (the sp. gr. of the distillate, rendered homogeneous by mixing, should be 0·880—0·887) at the ordinary temperature. The soda solution in the separator is here very necessary. A catch-box should also be placed between the dephlegmator and condenser, to retain any liquid carried over mechanically by the steam. If these precautions are not taken, the naphtha is apt to discolour.

The object of the apparatus and operations described above is to produce the different varieties of impure commercial benzene and of naphtha, a complete separation not being required. For the manufacture of dyes, however, practically pure benzene, toluene, xylene, &c., are required, and more elaborate distilling apparatus are employed. These are practically identical with the dephlegmating columns used in the rectification of spirit (which *see*). Among the best known are those of Savalle and of Siemens Bros.

Various forms of more or less pure benzene are manufactured for trade purposes. Of these, specially purified benzene is prepared by treating once-rectified benzene with sulphuric acid and then fractionating. Benzol for blue is also a very pure form of benzene, and should boil within half a degree centigrade of the pure product. Commercial 'chemically pure benzene' is made by cooling 'pure' benzene until it crystallises, and separating the crystals from the mother-liquor.

All these forms of benzene contain thiophene, C_4H_4S, a compound closely allied to benzene. It is a colourless liquid, boiling at 84° C., and having a sp. gr. of 1·07 at 15° C. This body can only be removed by treating benzene many times with strong sulphuric acid until a brown colour is no longer produced, or by passing chlorine through benzene cooled to 0° C and protected from the light, the benzene being afterwards rectified. The purest benzene is obtained by distilling benzoic acid with lime.

Estimation and Tests for. Benzene in quantity is easily recognised by its odour, boiling-point, and specific gravity. When only a small amount is being dealt with, it can be converted into nitrobenzene by treatment with nitric acid, and this in its turn reduced to aniline, which can be recognised by the usual tests. For the latter purpose, however, the benzene must be tolerably free from certain admixed substances, and it is consequently necessary as a rule to submit the crude liquid to a process of purification before the test can be applied. This generally consists in (1) treat-

ing the liquid with caustic soda, to separate phenols and acids; (2) distillation, the portion passing over at 65°—100° C. being collected apart; (3) treatment of this fraction with repeated quantities of strong sulphuric acid until the latter is no longer blackened; (4) treatment with dilute soda to remove traces of acid; and (5) one or two fractional distillations, the portion passing over at 80°—82° C. (176°—179·6° F.) being collected apart. The benzene, more or less concentrated and purified by the foregoing processes, is mixed with about twice its volume of nitric acid of 1·5 sp. gr. in a flask fitted with an inverted condenser and heated if necessary for a few minutes. The liquid is then cooled and poured into cold water, when the nitro-benzene collects at the bottom of the vessel in oily drops or as a finely divided precipitate (if the original substance contained paraffins, these will form an upper layer after treatment with nitric acid, and this should be separated by means of a tap-funnel before the pouring into water). The nitro-benzene is separated by pouring the liquid through a wet filter. It is washed and dissolved off the filter with a little alcohol, and the solution is then boiled with zinc and hydrochloric acid, and any aniline tested for by the addition of bleaching powder.

This test is very useful for distinguishing between 'benzoline,' sometimes called 'benzine,' and commercial 'benzol,' and for detecting any adulteration of the latter with the former. In this case it is only necessary to convert the benzene into nitro-benzene. After nitration the liquid will separate into three layers, the upper one consisting of unaltered paraffin, the second of nitro-benzene, and the third of a solution of nitro-benzene in nitric acid. The last two are poured into water, and the nitro-benzene separated and measured. It is advisable to treat the paraffin a second time with nitric acid.

Valuation of Commercial Benzols. Commercial benzols contain benzene and its homologues, carbon bisulphide, non-nitrifiable hydrocarbons known as 'petroleum,' thiophene, traces of water, acetylene and its homologues, and other impurities. Commercial benzols, as we have seen, are divided into 90%, 50%, 30%, &c., these values representing the percentages by volume which distil over below 100° C.

90% benzol should not begin to distil below 80° C., and should not yield more than 20% to 30% at 85° C., as this would indicate a large proportion of carbon bisulphide or light hydrocarbons. The average composition of a 90% benzol is 70% benzene, 24% toluene, and 4% to 6% carbon bisulphide. English 90% benzol has a sp. gr. of ·880 to ·888 at 15·5° C. (60° F.), but the density is not a very reliable indication, as 90% benzol is liable to contain carbon bisulphide (sp. gr. 1·27) and light hydrocarbons (sp. gr. about 0·860), which when present together do not materially affect the density. Scotch 90% benzol contains much of the second impurity, but little of the first, hence its sp. gr. is often as low as ·870 (*Allen*, 'Commercial Organic Analysis').

50% benzol, sometimes called 50-90 benzol, is a product 50% of which distils below 100° C., and 40% more below 120° C. It should distil wholly below 130° C. Sp. gr. (English) = ·878 to ·880, (Scotch) = ·867 to ·872. This variety of benzol contains little carbon bisulphide and petroleum, but larger quantities of toluene and xylene than 90% benzol. It is used in making the heavy aniline required for the manufacture of rosaniline.

30% benzol yields 30% below 100° C., 60% of the remainder distilling below 120° C. For the manufacture of aniline-red (also called magenta and fuchsine), a benzol is required which will yield an aniline oil of which three-fourths will distil between 180° and 190° C. and the rest between 190° and 215° C. Such an aniline is obtainable from a benzol of which three-fourths distil between 80° and 100° C. and the rest between 100° and 130° C. For methyl-violet, aniline as free as possible from higher homologues is required, being obtainable from a benzol distilling below 83° or 84° C. For xylidene-red an aniline oil derived from benzols boiling above 115° or 120° C. is needed (Allen's 'Commercial Organic Analysis'). In the assay of commercial benzols the following tests are made:—Determination of (1) specific gravity; (2) carbon bisulphide; (3) light hydrocarbons or 'petroleum;' (4) nitrifiable hydrocarbons; (5) behaviour on treatment with sulphuric acid and when fractionally distilled.

Before estimating other constituents it is necessary to dehydrate the benzol if the sample contains sufficient water to render it turbid. This is easily effected by shaking it with recently ignited plaster of Paris and filtering.

The determination of the specific gravity of commercial benzols frequently gives valuable information, especially if carbon bisulphide be removed before the determination is made. The removal of the carbon bisulphide is effected in the manner described below, the benzol being dehydrated with plaster of Paris after being shaken with water. A specific gravity determination is not easily made by means of the bottle, owing to the high rate of expansion of benzene, but is preferably found by means of a delicate hydrometer or of the *Westphal* balance, the sample being first carefully brought to a temperature of 15·5° C.

Carbon bisulphide is a frequent impurity in 90% benzol, and may exist there in comparatively large quantity without its characteristic odour being perceptible. Its presence is usually indicated by a high specific gravity. It may be separated and estimated by treating 100 c.c. of the dehydrated benzol with 1 grm. of caustic potash dissolved in 20 c.c. of hot absolute alcohol. The mixture is thoroughly shaken, when, if carbon bisulphide be present, it will become yellow and eventually pasty from precipitated potassium xanthate. After half an hour's shaking the precipitate is filtered off, and the filtrate shaken twice with water; the precipitate on the filter, after being washed with ether, is then dissolved in a little alcohol, this solution added to the aqueous extracts, and the whole acidified with acetic acid, and precipitated with cupric sulphate, which throws down cuprous xanthate, $CuC_2H_5(CO)S_2$, as a bright yellow precipitate, insoluble in water and dilute acids. The cuprous xanthate is washed, dried, and ignited in air, and the residual cupric

oxide, CuO, quickly weighed. The weight of the latter divided by 0·523 gives the weight of carbon bisulphide in the sample taken.

To determine the 'petroleum' and nitrifiable hydrocarbons, a mixture is made of 150 grms. of nitric acid of 1·40 sp. gr. with 200 grms. of sulphuric acid of 1·845 sp. gr., and, when thoroughly cooled, this mixture is slowly added to 100 grms. of the benzol contained in a 500 c.c. flask, the liquids being well mixed by agitation and cooled if they become hot. When quite cold, the nitrobenzene is separated from any light petroleum by means of a tap-funnel, washed first with dilute soda and afterwards with water, and weighed. 100 parts by weight of an English 90% benzol should give not less than 150 parts of nitro-benzene, and 100 parts of a Scotch 90% benzol not less than 135 parts. The 'petroleum,' after washing, is weighed or measured.

The action of sulphuric acid on 90% benzol is examined by agitating the sample with 1-20th of its volume of cold strong sulphuric acid. It should not be diminished in volume by more than ½%.

Fractional Distillation; Retort Test. This test is the one most usually adopted in examining benzols, naphthas, &c. As, however, a complete separation of the constituents is not aimed at, one or two distillations only being usually made, it is evident that the form of apparatus, rate of distillation, and barometric pressure will exert a marked influence on the result. For this reason it is usual to indicate in the contract-note the method to be adopted in the assay. The following is taken *verbatim* from a contract-note largely employed in commercial benzol transactions: "A quantity of 100 c.c. to be distilled in a glass retort of a capacity of 200 c.c.; bulb of thermometer to be placed 3-8ths of an inch from bottom of retort; distillation to be made over a naked flame, and at such a speed that the distillate shall not pass over in a stream, but as quickly as it can drop in separate particles. Any deficiency in quantity arising from evaporation or other natural causes during the operation to be added to the product at each point, and proper allowance to be made (if necessary) for the observed reading of the barometer" (from Allen's 'Commercial Organic Analysis').

The proportions which should distil below given temperatures for different varieties of benzol, naphtha, &c., have already been given. The following are the details for conducting the 'retort test.'

A retort, capable of holding in its usual position twice the amount of liquid to be distilled, is fitted to a Liebig's condenser, the retort neck being inserted into the condenser tube as far as it will go, and the lower portion being cut off if necessary. No cork or other connection is required. A thermometer with small bulb is passed through a cork fitted to the tubulure of the retort, until it is within 3-8ths of an inch from the bottom. The thermometer should be graduated to 130° C. in ½ or ⅕ degrees, and the 70° point should be quite outside the tubulure of the retort. The retort and condenser are first rinsed with the sample; 100 c.c. are then introduced and heated to boiling by a naked *Bunsen* flame, which should be small and so regulated that, as soon as the benzol boils, the distillate may fall from the end of the condenser into the 100 c.c. measure placed to receive it in rapid but distinct drops, not in a continuous stream. (It is very advantageous to use a *Bunsen* burner in which the air supply is cut off simultaneously with the gas.) As soon as the thermometer registers 85° C., or a little before this point, the flame is extinguished. Four or five minutes are then allowed to elapse for the distillate to drain from the condenser, when the volume of the latter is carefully read off and recorded. The distillation is now recommenced with the same precautions as before until the thermometer indicates 100° C., when a second reading is taken. Finally, the liquid remaining in the retort is allowed to cool, and is then poured into the measuring tube, any deficit in the total bulk from that originally taken being added to each reading. Thus, supposing 20 c.c. distilled at 85° C., and 90 c.c. (in all) at 100° C., and that the total mixed liquid after distillation measured 99 c.c., then 21 c.c. and 91 c.c. would be reported as the distillates up to the temperatures 85° and 100° C. respectively.

A different method is sometimes adopted in benzol testing, and consists in distilling the sample continuously from beginning to end, and noting the temperatures at the moments when 5, 10, 20, 30, &c., per cent. have passed over. This is known as the 'modified retort test.' In either test a much better idea of the probable richness

	Good 90 per cent. Benzol.	Good 90 per cent. Benzol.	Scotch 90 per cent. Benzol.	50 per cent. Benzol.	30 per cent. Benzol.	Solvent Naphtha.	Very good once run Naphtha.
Specific gravity	·8855	·882	·873	·880	·875	·877	...
1st drop collected at . . .	82½	82	...	...	...	...	...
10 per cent.	84	83¼	84½	94	97	128½	96
20 „	84¾	84½	85	95	98	130	99½
30 „	85½	85	85¾	96½	99½	132½	102
40 „	86¼	85¾	86½	98	101	135	107
50 „	87¼	86¾	87¾	100	104	137	111
60 „	88½	88	89	102½	106	140	119
70 „	90¼	89¾	91¼	106	109½	143½	128
80 „	93¼	92½	94¾	110½	113½	148½	145
90 „	...	...	...	120	120	156	170
92 „	100	100	100	...	...	...	...

of the sample in benzene can be obtained by conducting the distillation after the removal of carbon bisulphide, as described above. Where the test has not to comply with any commercial requirements, a much more perfect separation of the constituents, and therefore better idea of the value of the sample, can be obtained by using some form of dephlegmating apparatus. This usually consists of a tube on which four or five bulbs are blown, each bulb being closed below by a small basket made of platinum gauze. The lower end of the tube passes through a cork into the flask in which the distillation is conducted, while the upper end is furnished with a side tube which communicates with the condenser. A thermometer is placed inside the dephlegmator, so that its bulb is opposite the lateral exit. When the vapour passes into the dephlegmator, a portion of it condenses and partially fills the bulbs, so that the succeeding vapour becomes washed by passing through the liquid layer. Sometimes overflow tubes passing from bulb to bulb are provided, to prevent the latter becoming too full of liquid. Kempel's dephlegmator, consisting of a straight glass tube filled with glass beads, is very effective and simple. The subjoined table gives the behaviour of the more important benzols under the modified benzol test.

BENZIDINE, $C_{10}H_8(NH_2)_2$. *Syn.* DI-*p*-DI-AMIDO-DIPHENYL. A diatomic base, of especial importance in the colour industry.

BENZINE. A name given to one of the low-boiling fractions obtained in the distillation of crude petroleum. It is a mixture of fatty hydrocarbons, whose boiling-points are below that of the mixture which may legally be sold as 'kerosene,' or 'paraffin,' to be used for illuminating purposes. (cf. BENZOLINE.)

BEN'ZOATE (-zo-āte). [Eng., Fr.] *Syn.* BENZOAS, L. A salt of benzoic acid. The benzoates may in general be prepared by neutralising benzoic acid with the corresponding bases, *e. g.* benzoic acid added to ammonium hydrate forms ammonium benzoate. An insoluble benzoate may also be prepared by adding a solution of a soluble salt of the corresponding base to a solution of benzoic acid or of one of its salts, *e.g.* ferric benzoate is precipitated when ferric chloride is added to a solution of a salt of benzoic acid. The benzoates of the alkali metals and of ammonium are very soluble in water and alcohol; the other benzoates are for the most part only slightly soluble in cold, but dissolve to some extent in hot water.

BENZOIC ACID (-zō'-ĭk),

$$HC_7H_5O_2, = C_6H_5.CO_2H.$$

Syn. FLOWERS OF BENZOÏN; ACIDUM BENZO'-ICUM (B. P.); ACID BENZOÏQUE, FLEURS DE BENJOIN, &c., Fr.; BENZOESÄURE, &c., Ger. *Sources.* Benzoic acid occurs in various resins, *e.g.* gum benzoïn, dragon's-blood, storax, and balsams of Peru and Tolu; and in putrid urine, where it is formed by the decomposition of hippuric acid.

Prep. 1. From gum benzoïn (*a*) in the dry way, by sublimation; (*b*) in the moist way, by digestion with milk of lime. 2. From hippuric acid, or from putrid urine. 3. Indirectly from naphthalene. 4. From toluene. Of these methods, 1(*a*), 2, and 3 are used on the large scale; sometimes also 4.

1 (*a*). Good benzoïn is coarsely powdered, and placed in a flat cylindrical iron vessel from 8 to 9 inches in diameter, so as to form a layer 1 or 2 inches deep. The vessel is covered with a sheet of filter-paper, attached to the rim with paste, and over all this a conical cap of strong cartridge-paper is fitted by means of paste and string. The apparatus is placed on a sand-bath, and kept at a gentle heat for four to six hours; it is then allowed to cool and the paper cap is detached, when crystals of benzoic acid are found within the latter. If the product is coloured, it must be pressed between blotting-paper and re-sublimed; but re-sublimation should be avoided if possible, as it entails a considerable loss of acid. Gum benzoïn yields 10% to 12% of 'flowers,' or 'acid of the first sublimation;' and this, after re-sublimation, yields 8% to 10% of pure benzoic acid.

1. (*b*) *Scheele's Process.* Gum benzoïn is well mixed with an equal weight of slaked lime, the mixture repeatedly boiled out with water, and the filtrate evaporated to 1-6th of its original bulk, treated with bleaching-powder solution, and then boiled with hydrochloric acid until all the chlorine has been removed. The acid separates out on cooling, and is re-crystallised from hot water. This is an economical and productive process, but to ensure success the dry ingredients must be perfectly mixed, as otherwise the benzoic acid runs into a solid mass in the boiling water, and the operation fails.

Stoltze's Process. Gum benzoïn is dissolved in 3 times its weight of alcohol, the solution is introduced into a retort, and the free acid present is neutralised by adding a solution of sodium carbonate; water, equal to about twice the weight of the benzoïn employed, is then added, and the alcohol removed by distillation. The floating resin is now skimmed off the residual liquid, and washed with a little water. The washings are added to the liquid in the retort, which is then concentrated and cooled, when it deposits crystals of sodium benzoate. By decomposing these with hydrochloric acid, crystals of benzoic acid are obtained, and may be purified by sublimation.

2. The urine of cows or horses is allowed to stand for several days, and then clarified with milk of lime; the clear solution is evaporated to 1-4th of its bulk, and the benzoic acid is precipitated by the addition of hydrochloric acid. Since the evaporation produces a very unpleasant smell, it is better to precipitate the excess of lime with carbonic acid, and add ferric chloride to precipitate ferric benzoate, which is then decomposed by hydrochloric acid. The acid thus obtained is purified by being redissolved in milk of lime with the addition of a little bleaching-powder solution, precipitated by hydrochloric acid, and recrystallised from hot water. The final product (*acidum benzoicum ex urinâ*) still smells of urine, and is not employed for pharmaceutical purposes; the smell may, however, be disguised by the addition of some of the sublimed acid. About 2 kilos of the acid are obtained from 1000 kilos of urine.

3. Naphthalene is oxidised with nitric acid to phthalic acid, which is then neutralised with lime, and the calcium phthalate formed heated for several hours to about 340° C. (640° F.) with

slaked lime in a covered vessel. Calcium benzoate and carbonate are formed, and benzoic acid may be obtained from the product by the addition of hydrochloric acid.

4. Toluene is chlorinated whilst boiling, and the benzyl chloride formed is boiled with 3 parts of nitric acid (of 1·313 sp. gr.) and 2 parts of water for about 10 hours in an apparatus connected with an inverted condenser, until the smell of benzyl chloride and benzaldehyde has disappeared; the liquid solidifies on cooling to a crystalline mass, no oily drops being formed.

Starting proposes ('Arch. Pharm.') that this acid should be made in the following manner on the small scale: The subliming vessel is a copper or brass pan, 3 in. in diameter and 2 in. deep, which is carefully fitted into the bottom of a wooden box, $2\frac{3}{4}$ ft. long by 1 ft. wide and 1 ft. deep, either smoothly planed inside or lined with glazed paper. The lid and joints of the box are made tight from the outside. A disc of pasteboard is hung 2 or 3 in. above the pan, to prevent the sublimate from falling back into it. The pan is charged with 35 grms. of powdered gum benzoïn, and heated for about four hours by means of a small spirit-lamp. The pan is charged a dozen times or more before the box requires emptying. The acid obtained shows only the faintest trace of yellow colour.

Benzoic acid may also be formed by the oxidation of benzaldehyde or oil of bitter almonds; this substance, indeed, deposits benzoic acid when it is left exposed to the air.

Prop. Benzoic acid is obtained in white flexible needles by sublimation, in pearly white plates by deposition from an aqueous solution. The pure acid is inodorous when cold, but acquires a faint smell when gently warmed; the acid of the shops has a pleasant aromatic odour, due to the presence of an ethereal oil derived from the gum benzoïn from which it was prepared. Benzoic acid melts at 121° C. (250° F.), boils at 249° C. (480° F.), and begins to volatilise at 100° C. (212° F.), the sublimation being rapid at 140° (284° F.); the vapour is very suffocating and irritating. Sp. gr. = 1·291; vapour density = 4·27. It is very sparingly soluble in cold water, more soluble in boiling water, soluble in 4 parts of alcohol; it is also soluble in ether. It is attacked by fuming nitric acid, but is unaffected by ordinary nitric acid, even when boiling. When distilled with lime it yields benzene. It is soluble in caustic alkalies and hydrate of lime, soluble salts (BENZOATES) being formed; the presence of borax, or phosphate of sodium, also increases its solubility in water. When added to fatty substances it prevents, or at least greatly retards, their becoming rancid.

Uses, &c. Its chief use in *medicine* is as a stimulant, expectorant, and diuretic. It is an ingredient in the compound tincture of camphor (paregoric elixir) of the Pharmacopœia. A lozenge of benzoic acid is also official.—*Dose*, 10 to 30 gr., dissolved in water by the aid of a little ammonia or potassa; in old coughs, &c.

Tests for. Benzoic acid may be recognised (1) by its physical properties (see *above*); (2) by its solubility in alkalies, from which solutions the stronger acids precipitate it as a dazzling white powder, only sparingly soluble in cold water; (3) by its neutral solution in alkalies giving with a solution of ferric chloride (neutralised with ammonia) a light brown precipitate of ferric benzoate, decomposed by hydrochloric acid, with separation of benzoic acid; (4) by its solution giving, after neutralisation with soda or potash, a white flocculent precipitate with lead acetate; (5) by a mixture of alcohol, ammonia, and barium chloride, giving no turbidity with solutions either of the free acid or of one of its salts.

It is distinguished from cinnamic acid by yielding no essential oil of almonds (benzoic aldehyde) when it is distilled with an oxidising agent, such as a mixture of potassium bichromate and sulphuric acid; from succinic acid by tests 3 and 5 above.

Estimation. 1. By weighing it as benzoic acid, obtained either by precipitation or by very careful sublimation in a glass apparatus. 2. By neutralising its alcoholic or aqueous solution with a standard solution of an alkali (see ACIDIMETRY). 3. By precipitating its neutral solution with lead acetate or ferric chloride, and washing, drying, and weighing the lead or ferric benzoate formed.

Adulterations. Hippuric acid, which can be detected by its different crystalline form, by its lesser solubility in cold water, and by its exhaling an odour of Tonquin beans, and afterwards of hydrocyanic acid, when sublimed. *Succinic acid*, detected by its greater solubility in cold water. *Sugar*, detected by its greater solubility, and by its evolving an odour of caramel and leaving a black carbonaceous residue when heated. *Camphor*, detected by its peculiar odour when gently warmed. *Spermaceti*, specially prepared for the purpose, is an occasional adulterant; it is detected by its insolubility and by other properties. All these substances possess a different crystalline form from benzoic acid, and also greatly increase its specific gravity.

BENZOIC ALDEHYDE. C_7H_6O, = $C_6H_5.CHO$. *Syn.* HYDRIDE OF BENZOYL, ESSENCE OF OIL OF BITTER ALMONDS, HUILE OF ESSENCE D'AMANDES AMÈRES, Fr.; BENZALDEHYD, BITTERMANDELÖL, Ger.

Prep. Benzoic aldehyde may be prepared by many different methods; of these three only, which are used on the large scale, will be described here.

1. Bitter almond oil, which is benzoic aldehyde containing some prussic acid in solution, is agitated with a dilute solution of ferrous sulphate mixed with some freshly slaked lime; the mixture is then distilled, and the distillate allowed to stand, when the aldehyde settles down, leaving an upper layer of water. The water is siphoned off and the treatment repeated, and the aldehyde finally obtained is dried by allowing it to stand over fused calcium chloride. If required very pure, it is further treated with a saturated solution of sodium sulphite (Na_2SO_3), and the resulting crystalline compound is washed with alcohol, crystallised from water, and then decomposed by a boiling solution of sodium carbonate; the aldehyde is separated from the aqueous solution and dried as described above. In the above process oxide of mercury is sometimes used instead of ferrous sulphate and lime.

2. Two parts of benzoyl chloride ($C_6H_5.CHCl_2$) are boiled with 3 parts of lead nitrate, or better, copper nitrate, and 10 parts of water for several hours, in a vessel connected with an inverted condenser, the operation being conducted in a current of carbonic acid; half the liquid is then distilled off, and the oil (benzoic aldehyde) is separated from the water in the distillate.

3. It is also prepared by heating benzyl chloride ($C_6H_5.CH_2Cl$) under pressure in an iron vessel with caustic soda.

Prop. A colourless (and when freed from prussic acid), non-poisonous, highly refractive oil, possessing an agreeable bitter-almond-oil odour; its sp. gr. is 1·050, it boils at 179° C. (354° F.), dissolves in 30 parts of water, and mixes with alcohol and ether in all proportions. When exposed to the air it rapidly absorbs oxygen, forming crystals of benzoic acid; with alkaline sulphites it yields crystalline compounds; when heated with acetic anhydride and sodium acetate it forms sodium cinnamate, and it reacts with derivatives of aniline in the presence of zinc chloride, forming various colouring matters.

Uses. Benzoic aldehyde is used in perfumery and as a flavouring; great care is, however, necessary in its use. On the large scale it is employed in the manufacture of aniline colours, such as *malachite-green*, and also to make cinnamic acid as a first stage in the artificial production of indigo.

BENZOIN′, B. P. (-zoyn′; -zō′-ĭn). *Syn.* Gum benzoïn*‡, Ben′jamin†*, Gum b.†*; Benzöi′num, L., B. P.; Ben′join, Fr.; Benzoe, Ger. Gum benzoïn is obtained from *Styrax benzoïn*, Dry. A moderate-sized tree, found abundantly in Sumatra (where also it is cultivated), Java, and in Borneo and the Malay Peninsula, where, probably, it has been introduced. Benzoïn of commerce is obtained both from Sumatra and Siam. It is collected in Sumatra by cutting deep incisions into the bark when the trees are about six or seven years old; as the resin exudes it becomes hard, and is scraped off with a knife. The best quality is that which is obtained during the first three years, and for the next seven or eight years the produce is browner in colour and less valuable. A quantity of benzoin is scraped from the wood of the tree after it is cut down, which is of a still darker colour, and is often mixed with pieces of bark and other impurities. Sumatra benzoin always comes into commerce in lumps, and is of inferior quality to that from Siam, which comes either in tears or in masses of agglutinated tears. Benzoin is used as a stimulant and expectorant in chronic bronchitis and other affections of the lungs. It is one of the principal ingredients in 'Friar's balsam.' Its chief use, however, is for incense.

Prop., &c. Odour agreeable, and somewhat like that of vanilla, but more balsamic; fracture conchoidal; lustre greasy; sp. gr. 1·063 to 1·092. It fuses at a gentle heat, and exhales white fumes, which, on condensation, are found to be benzoic acid contaminated with a little volatile oil. Alcohol dissolves the larger portion of it, ether much less, and the volatile and fixed oils only a little. It contains from 9% to 18%, or (occasionally) nearly 20%, of benzoic acid, according to the quality. It burns with an agreeable odour. The resin and its alcoholic solution strike a bright red colour with oil of vitriol, and a green colour with chloride of iron.

Benzoin has occasionally been sold by fraudulent dealers after its benzoic acid has been removed by the wet method. When the gum has been thus treated it will not show the agglutinated tears, upon fracture, which commonly distinguishes it when intact.

Uses, &c. It is chiefly employed in perfumery, and as an ingredient in incense, fumigating pastilles, &c.; also in court plaster, in certain cosmetics, and to scent the varnish used for snuff-boxes, walking-sticks, &c. As a medicine, its general effects resemble those of the other true balsams, and of benzoic acid.—*Dose*, 5 or 6 to 20, or even 30 gr., in powder, and usually in combination with some other remedy; chiefly in chronic pulmonary and bronchial affections, when occurring in torpid habits, and unaccompanied by inflammatory symptoms or gastric irritation. Also as a fumigation in the same diseases, hooping-cough, &c. Like benzoic acid, it is used to prevent rancidity in ointments, pomades, and other fatty preparations. Compound tincture of benzoin, also known as Friar's balsam, and traumatic balsam, is contained in the Pharmacopœias.

BENZOINUM. See Benzoin.

BENZOLINE. *Syn.* Benzine, Benzin, Petroleum spirit, Petroleum naphtha. This product is obtained by the fractional distillation of American petroleum or of Scotch shale oil, and consists of a complex mixture of paraffins of the general composition C_nH_{2n+2}, and of olefines having the composition C_nH_{2n}.

The fractional distillation of petroleum or shale oil is carried out in much the same manner as that of coal-tar (which *see*), the different fractions being treated successively with sulphuric acid and caustic soda, to a greater or less extent according to the purpose for which they are intended. The fractions are the same whether petroleum or shale oil is the substance operated upon, with the exception of 'vaseline,' which is obtained only from petroleum. The chemical composition of the respective distillates is also much the same, the only difference being that petroleum is richer in paraffins, and shale oil in olefines.

The table on the next page represents the fractions usually obtained from petroleum and shale oil respectively.

Cymogene consists mainly of butane, C_4H_{10}, which is a gas at the ordinary temperature. It is sometimes condensed by pressure, and used in freezing machines.

Rhigolene consists chiefly of pentane and iso-pentane, both C_5H_{12}, and gasolene of hexane and iso-hexane, both C_6H_{14}. The first is used for producing local anæsthesia, and together with gasolene for gas engines and for carburetting air and coal-gas. These portions boil below 60° C. (140° F.), and are known collectively as mineral ether.

The next three fractions form benzoline, which consists chiefly of heptane, C_7H_{16}, and octane C_8H_{18}, together with the lower homologues. It is largely used as a solvent and for burning in

Products.		From Petroleum.		From Shale Oil.	
		Specific Gravity.	Percentage.	Specific Gravity.	Percentage.
	Cymogene	·590	Very small		Very small
Petroleum ether	Rhigolene	·625–·631	„		„
	Gasolene	·636–·657	1–1·5	·730	5
Petroleum spirit or benzoline	'C' naphtha ('benzine-naphtha')	·700	10		
	'B' naphtha	·714–·718	2·5		
	'A' naphtha ('benzine')	·725–·737	2–2·5		
	Kerosene or burning oil	·802	50–55	·800–·810	37
	Lubricating oil	·875	17·5	·885	17
	Paraffin wax	...	2	...	13
	Coke, gas, and loss	...	8–10	...	28

sponge lamps. It is a thin colourless liquid, having a peculiar odour. It gives off inflammable vapours at the ordinary temperature, and evaporates rapidly.

Benzoline dissolves caoutchouc, asphalt, colophony, mastic, and dammar resin (resins are dissolved by naphthas B and C only). It also dissolves the oils of almonds, olive, rape, linseed, cod liver, croton, cocoa-nut, and palm; likewise lard, naphthalene, wax, paraffin, &c. It mixes in all proportions with amyl alcohol, ether, chloroform, benzene, oil of turpentine, creosote, and cresylic acid, but not with carbolic acid. It is soluble in 6 parts of rectified spirit.

Benzoline or petroleum spirit should leave no odour when evaporated on the hand, and should evaporate completely when heated over the water-bath. It should be free from sulphur compounds if it is to be used as a turpentine substitute, as the presence of these would injure the colour of lead pigments.

Sulphur in benzoline can be detected by boiling the sample with alcohol and a few drops of ammonia, and then adding silver nitrate. The liquid will turn brown if sulphur is present. When benzoline is agitated with warm water the latter should remain neutral, and should give no precipitate with barium chloride. A precipitate with the latter would indicate the presence of sulphuric acid or sometimes sulphonates. Dissolved or admixed water is very injurious to the burning properties of benzoline; it may be easily removed by shaking the oil with recently heated plaster of Paris, and filtering.

The terms benzoline and benzine have led to much confusion between the product obtained from petroleum or shale oil and that from coal-tar naphtha, which contains benzene, C_6H_6. Methods of detecting petroleum spirit and coal-tar naphtha, and of separating them when mixed, are given under BENZENE.

BENZOYL $(C_6H_5.CO)'$-. The (unsaturated) radicle of a large number of compounds, of which benzoic aldehyde (*benzoyl hydride*), $C_6H_5.CO.H$, and benzoic acid (*benzoyl hydrate*), $C_6H_5.CO.OH$, are the most important.

BENZOYL-ECGONINE. *Syn.* BENZOYL-ECGONINA, L. A by-product obtained in the manufacture of cocaine, from which it is produced by the action of hydrochloric acid.

BENZYL AL'COHOL. $C_6H_5.CH_2OH$. A colourless liquid of weak aromatic odour, discovered by M. Cannizzaro, and obtained by the action of an alcoholic solution of potassa on pure oil of bitter almonds.

BER'BERINE (-ĭn). This substance must not be confounded with BEBERINE or BIBERINE (which *see*). $C_{20}H_{17}NO_4$. [Eng., Fr.] *Syn.* BAR'BERĪNE*, BER'BERITE* (of Thomson); BERBERI'NA, L. A substance discovered by Buchner and Herberger in the root of the common barberry shrub (*Ber'beris vulgā'ris*, Linn.) and subsequently, by Bödecker, in calumba root; likewise by J. W. Lloyd from *Hydrastis canadensis.*

Prep. 1. A soft watery extract of the root, or of the wood, is digested in rectified spirit, with trituration, as long as anything is taken up; the resulting tincture, after repose, is filtered, and the alcohol gradually distilled off until the residuum has the consistence of a thin syrup. The crystals which form as the liquid cools are drained in a funnel, washed with a few drops of ice-cold water, pressed dry in bibulous paper, and then purified by solution and crystallisation, first in rectified spirit, and next in distilled water.

2. By digesting the root, or the wood (coarsely powdered) in rectified spirit, and then proceeding as before.

Berberine is a somewhat weak base, when pure its colour is lemon-yellow. It forms salts, some of which are very soluble, especially the phosphate, others insoluble; berberine is soluble in 4½ parts water at 60°—70° F., it dissolves moderately in alcohol, but is insoluble in ether and chloroform. It changes to orange colour when heated to 150° F., and assumes its original shade on cooling.

Hydrochlorate of Berberine. Dissolve berberine in 16 times its weight of water, and cautiously stir in hydrochloric acid until in slight excess; drain the precipitate and dry by exposure to air. Hydrochlorate of berberine is soluble in about 500 parts water. It is one of the most difficult salts of berberine to decompose, holding its acid in the presence of alkalies (*J. V. Lloyd*).

Uses, &c. Chiefly in medicine, in similar cases to those in which the use of calumba-root is indicated. It has been highly recommended in dyspepsia and heartburn, in disturbed action of the liver, and, combined with iron (lactate, phosphate, or hyposulphite), in chlorosis, anæmia, &c.

According to M. Altin, it is an effectual remedy for the mucal colourless diarrhœa, and the derangement of the urinary secretions which commonly follow cholera.—*Dose,* 3 to 10 gr.; in larger doses it proves laxative. See CALUMBA, &c.

BERG'AMOT. *Syn.* BERGAMO'TA, L.; BERGAMOTE, Fr.; BERGAMOTTE, Fr., Ger. The bergamot lemon, or fruit of *Citrus bergamia;* also sometimes, colloquially, the fragrant oil obtained from its rind. See OILS (Volatile).

BERGBALSAM--MOUNTAIN BALSAM (of *G. Schmidt,* Berlin). Recommended for hæmorrhoids, want of appetite, headache, constipation, &c. Rhubarb, 2 parts; cortex frangulæ, 10 parts; milfoil flowers (*Achillea millefolium*), 1 part; tansy, 1 part; crystallised soda, 1½ parts; to be digested for some hours in warm water, the fluid expressed made up to 26 parts, 30 parts of sugar dissolved in it, and lastly mixed with 17 parts of rectified spirit (*Hager*).

BERLIN BLUE. See PRUSSIAN BLUE; FERROCYANIDES.

BER'RY (bĕr'-re). *Syn.* BAC'CA (pl. *baccæ,* -sē), L.; BAIE, Fr.; BEERE, Ger. Any small succulent or pulpy fruit containing several naked seeds or granules. In *botany,* an indehiscent pericarp or seed-vessel, pulpy, many-celled, and many-seeded, the seeds being naked, and for a time connected by a slender membrane, from which they become detached at maturity, and then remain dispersed through the pulp. It is distinguished by its figure, &c., into several varieties.

The leading berries employed in domestic economy and the arts are noticed in their alphabetical places (which *see*).

BER'YL (bĕr-rĭl). *Syn.* AQUAMARINÉ (rēne); A'QUA-MARI'NA, BERYL'LUS, L.; AIGUE-MARINE, BÉRIL, Fr.; BERYLL, &c., Ger.; SMARAGD, It. A beautiful mineral, which, in its richer forms, is classed with the gems. It is usually of a green colour of various shades, passing into honey-yellow and sky-blue. It is allied in composition to the emerald; but occurs in much larger crystals than that gem, and owes its colour to oxide of iron instead of oxide of chromium. According to Gmelin, its composition is—silica, 68·7% ; alumina, 17·6% ; glucina, 13·4% ; red oxide of iron, ·24%. Other (previous) authorities state that it contains fully 14% of glucina, 2% of lime, and 1% of oxide of iron.

The finest beryls come from Dauria on the frontiers of China, from Siberia, and from Brazil. Some of gigantic size have been found in the U.S., at Ackworth and Grantham, New Hampshire, and at Royalston, Mass. One of these measured 32 × 22 × 15 in., and weighed 2900 *lbs.;* another, 12 × 24 × 45 in., and weighed 1076 *lbs.*

Apatite or Saxony beryl, chrysolite or pierre d'asperge, coloured fluor-spar, and even natural crystals of phosphate of iron, are often worked up by the lapidaries and passed off as beryls, or false beryls, emeralds, topazes, &c. See GEMS, PASTES, &c.

BERYL'LA*. See GLUCINUM, OXIDE OF.

BERYL'LIUM*. See GLUCINIUM.

BETAINE, $C_5H_{11}NO_{21}$. An alkaloid occurring in the juice of the mangold-wurzel. Scheibler prepares it as follows; – The expressed juice of the mangold-wurzel, strongly acidulated with hydrochloric acid, is mixed with a solution of sodium phosphotungstate (prepared by dissolving sodium bitungstate in ordinary phosphoric acid, adding hydrochloric acid, and decanting the clear solution from the precipitate thereby produced); the resulting precipitate containing albumen, colouring matter, woody fibre, and a small quantity of the base, is filtered as quickly as possible, and the filtrate, mixed with a fresh quantity of the precipitant, is left to itself for eight or ten days. It then gradually deposits on the bottom and sides of the vessel a crystalline precipitate, which is rinsed with a little water and treated with milk of lime, whereby insoluble calcium phosphotungstate is produced, while the betaine remains in solution. The filtered liquid freed from lime by carbonic acid, and evaporated, leaves impure betaine, which may be purified by recrystallisation from alcohol, with help of animal charcoal.

A hydrochlorate, a sulphate, an aurochloride, and a platinic chloride of betaine have been prepared.

BETEL (bē'tl). [Eng., Ger.] *Syn.* BE'TLE, BE'TEL-TREE, B. PEPPER-TREE; BÉTEL, Fr.; WASSERPFEFFER, &c., Ger.; PI'PER BE'TEL, Linn., CHAVICA BETLE, Miquel, L. A climbing plant of the Nat. Ord. PIPERACEÆ, common in India and the East. Its leaves, which somewhat resemble those of the citron, are bitter, stomachic, tonic, stimulant, and sialogogue.

Betel. A common masticatory in the East, where it is chewed in the same way as tobacco is by Europeans and Americans, but much more generally, being regarded by the Malays, Sumatrans, &c., as an absolute necessary of life. It is commonly formed by dividing areca-nuts (in many cases suitable pieces of the whole fruit, including the husk, are used; and in others only the husk (PINANG); there being different strengths and qualities of 'betel' employed) into four or six equal parts or slices, one of which is rolled up, with a little chunam (lime made by burning shells) in a sirih or leaf of the piper-betel (in some cases, the leaf of *Chavica siriboa,* Miq., which possesses similar properties, is employed), and then constitutes a 'quid' ready for use.

BETEL OIL. The dried leaves of *Piper betle* yield on distillation 0·5 % of oil, sp. gr. 1·024 at 15°, containing 70–75 % of a phenol which Bertram and Gildemeister have isolated by shaking with dilute aqueous soda, and decomposing the sodium compound with sulphuric acid. The product is *betelphenol,* $C_{10}H_{12}O_2$, a colourless, highly refractive oil of characteristic odour; boiling at 254°—255°, and of sp. gr. 1·067 at 15°. It has the same empirical composition as eugenol, but gives a greener colour with ferric chloride. It also differs from the phenol (chavicol) obtained by Eykman from the oil of the fresh leaves. The portion of the betel oil not affected by alkali distilled for the most part between 250° and 275° as a yellow liquid smelling like tea, and yielded crystals of a sesquiterpene dihydrochloride, $C_{15}H_{24}2HCl$.

Prop., &c. Betel, in those accustomed to its use, produces a species of pleasing excitement or intoxication, stimulates the action of the salivary

glands, stomach, and kidneys, corrects acidity, diminishes cutaneous perspiration, restrains excessive discharges, increases the power of physical exertion and endurance, moderates the effects of climate, and appears to act as a general tonic on the system. It darkens the teeth, and tinges the saliva as well as the mouth and lips of a bright red colour. In those unhabituated to its use it causes giddiness, astringes and excoriates the mouth and fauces, and temporarily deadens the sense of taste. The Indians conceive that it preserves and fastens the teeth, cleanses and strengthens the gums, sweetens the breath, cools the mouth, assists respiration, and acts as a general aphrodisiac on both sexes. Peron states that he preserved his health during a long and very trying voyage by the habitual use of betel, whilst his companions, who did not use it, died mostly of dysentery ('Voyage aux Terres Australes').

BE'TEL-NUT. *Syn.* ARE'CA-NUT; NUX ARE'CÆ CAT'ECHU, N.-BE'TEL, &c., L. The seed of the catechu-palm (*Are'ca cat'echu,* Linn.), divested of the husk or fibrous pericarp. The whole fruit (ARECA-NUT of commerce) is about the size of a small egg; the husked nut is of the size of a large nutmeg. The whole fruit is remarkable for its narcotic or intoxicating power. It has, however, been thought doubtful whether its intoxicating effect is not owing to the piper-leaf in which it is wrapped when eaten (chewed), rather than to any special property of its own.

The nut contains about 15% of tannin substances, 14% of fat, colouring matter, &c. Its most important constituents are two alkaloids named *Arecoline* and *Arecaine.* The former is an oily liquid forming crystalline salts, and is the constituent upon which the action of the nut as a vermifuge depends. The latter is a crystalline solid forming crystalline salts; it appears to be inert as regards therapeutic action.

BETULA BHOJPATTRA, Wall, a moderate-sized deciduous tree of the higher ranges of the Himalaya. The thin bark is used as paper for writing and packing, also for roofing houses, for umbrellas, and for the tubes of hookahs. The wood is largely used for building purposes.

BETU'LINE (-ū-lĭn; bē'-tū). [Eng., Fr.]. *Syn.* BETULI'NA, L. A crystalline substance obtained from the bark of the white birch (*Be'tŭla al'ba,* Linn.).

BE'ZOAR (-zōre). [Eng., L. indecl.; prim. Pers.] Some authorities derive this word from *badzahr* or *pazahar,* Persian compounds implying 'antidote to poison;' others, from *paseng,* or *pasahr,* the name of the goat in Persia. Mayne's notation—*bez'oar,* is unusual; and several of his analogues, synonymes, &c., are incorrectly given (? misprinted). *Syn.* BE'ZOAR-STONE; BEZOÄR'DUS, LA'PIS BEZOÄR'DICUS, &c., L.; BÉZOAR, BÉZOARD, Fr,; BEZOARSTEIN, Ger. The name of preternatural concretions found in the stomach, ntestines, &c., of certain animals, and formerly supposed to possess the most extraordinary antidotal power and medicinal virtues. So far, indeed, did this belief extend, that other substances regarded as antidotes were called BEZOAR'DICS†, or otherwise named after them; whilst the adj. BEZOAR'DIC† (bĕz-) and BEZOAR'TICAL (bĕzoardique, Fr.; bezoar'dicus, L.), came to be synonymous with antidotal. Certain bezoars were once valued at even ten times their weight in gold. They were not only taken internally, but also worn as amulets. They have, however, long since fallen into disuse in this country.

Among the leading bezoars of old medicine are:

Bezoar, Ger'man. *Syn.* BEZOÄR GERMANI'CUM, B. CAPRI'NUM, L. From the Alpine goat.

Bezoar, Hu'man. *Syn.* B. HOM'INIS, L. Falsely stated to be found occasionally in man.

Bezoar, Microcos'mic. *Syn.* B. MICROCOS'MICUM, L. Human urinary calculi.

Bezoar, Mon'key. *Syn.* B. SIM'IÆ, LA'PIS S., L. From certain species of ape or monkey, obtained by giving an emetic.

Bezoar, Occiden'tal. *Syn.* WEST'ERN B.; B. OCCIDEN'TALE, L. Found in the fourth stomach of the chamois or wild goat of Peru, &c.; or, according to others, of a species of antelope.

Bezoar, Orien'tal. *Syn.* EAST'ERN B.; B. ORIENTA'LE, LAPIS, B., ORIENTA'LIS, L. From the fourth stomach of *ca'pra æga'grus,* a species of goat inhabiting the mountains of Persia, &c.

Bezoar, Ox. *Syn.* B. BOVI'NUM, L. From the ox, and other bovine animals.

Bezoar, Porcupine. *Syn.* B. HYS'TRICIS, B. HYS'TRICUS, LA'PIS H., L. PORCI'NUS, &c., L. Said to be found in the gall-bladder of the Indian porcupine. Chiefly from Malacca. Has an intensely bitter taste, which it imparts to water.

Bezoar, West'ern. See OCCIDENTAL BEZOAR (*antè*).

Of the preceding, those from the stomach of ruminants vary in size from that of a bean to that of a hen's egg, and have a composition and appearance closely imitated by the following formula, the product of which is commonly sold for them:

Bezoar, Facti''tious. *Prep.* From pipe-clay, or clay and chalk, equal parts, made into a stiff paste with ox-gall; a little hair or wool being added, and the resulting mixture pressed by the hands into small masses of a flattened spheroidal or egg-like form. These give a yellow tint to paper rubbed with chalk, and a green one to quick-lime, which tests are used for genuine bezoars. Like the latter, they are antacid or absorbent, which is probably the only virtue they possess.

Amongst 'chemical bezoars' now obsolete even on the Continent were—

Bezoar, Ar'gentine†; B. LUNA''RE, L. Made by distilling butter of antimony with a solution of nitrate of silver. Once highly esteemed in epilepsy and head diseases.

Bezoar, Mineral; B. MINERA'LE, L. Powder of algaroth deflagrated with nitre in a red-hot crucible, and then well washed with water. Once used as a diaphoretic. Other similar preparations were B. JOVIA'LE (from tin), and B. MARTIALE (from iron).

Bezoar, Sat'urnine, B. OF LEAD; B. SATUR'NI, L. Made by distilling a mixture of oxide of lead, butter of antimony, and nitric acid. Once highly esteemed in diseases of the spleen.

BHANG or **SIDEE,** the larger leaves of the hemp plant, dried, roughly broken, and mixed

with some of the fruits. It is dark green in colour, and has a strong narcotic odour and taste. It is chiefly used in India for smoking, and an intoxicating drink is prepared by infusing it in water. Bhang when mixed with flour, sugar, &c., is made in India into a kind of sweetmeat called 'Majoon.'

BHANGRA, herb of, *Eclipta alba*, Hassk., used in Hindoo medicine as a tonic and in tattooing for producing an indelible bluish-black.

BHAURTA. In Indian cookery, a dish made of mashed potatoes and onions, strongly spiced with capsicum, and sometimes also with curry-powder, shaped in a mould, and then slightly baked.

BIBAS'IC. *Syn.* DIBASIC (see ACID); BIBAS'ICUS, L.; BIBASIQUE, Fr.

BIB'ERON (bĭb'-rōng). [Fr.] A sucking-bottle or 'artificial mother.' See BOTTLES.

BIBIRINE (bē'-). See BEBERINE.

BI'B'ULOUS (-ū-). *Syn.* BIB'ULUS, L.; SPONGIEUX, Fr. Absorptive; spongy.

BICAR'BONATE. A salt in which only half of the hydrogen in (the hypothetical) carbonic acid (H_2CO_3) is replaced by a metal, *e.g.* bicarbonate of sodium, $NaHCO_3$,

BICE (bīse). *Syn.* BLUE BICE. See BLUE PIGMENTS.

Bice, Green. See GREEN PIGMENTS.

BICKEL'SCHER THEE, for constipation, flatulence, hæmorrhoids, loss of appetite, stomach complaints, and similar diseases. Cassia lignea and anise, of each 3 parts; cumin and fennel seed, each 4 parts; senna leaves, 20 parts; to be bruised together (*Selle* and *Hager*).

BI'DERY (bē'-). *Syn.* VI'DRY. An alloy of which the chief seat of the manufacture is the city of Bider', near Hyderabad, India. It was first brought under the notice of the British public at the International Exhibition of 1851, where many articles made of it were greatly admired for the elegance of their forms and the gracefulness of their engraved and enchased patterns.

Prep. 1. Zinc, 31 parts; copper and lead, of each 2 parts; melted together, with the usual precautions, under a mixture of resin and bees-wax, to prevent oxidation.

2. (*Dr Heyne.*) Copper, 8 parts; lead, 2 parts; tin, 1 part; melted together, as before. For *use*, the resulting alloy is re-melted, and to every 3 parts of it 16 parts of zinc are added.

Prop., &c. Colour between that of pewter and zinc; does not corrode by exposure to air or damp: yields little to the hammer, and can only be broken by extreme violence. It possesses a convenient degree of fusibility, above that of zinc and tin, but much lower than that of copper. For the turner it is usually cast in moulds of baked clay; but otherwise in moulds of iron or other hard metal. The beautiful black colour which the finished articles possess is imparted by dipping them into a solution of sal-ammoniac, saltpetre, sea-salt, and blue-vitriol. See BRASS, BRONZE, PEWTER, &c.

BIDET' (bĭd-ĕt'; -ā'—Fr.). An article of bedroom furniture conveniently formed for laving the lower part of the body. Besides the value of its use as an instrument of personal cleanliness and health, it offers a ready means of medicating the parts, often highly serviceable in piles, prolapsus, affections of the scrotum and prostate gland, strangury, ischuria, suppressed or difficult menstruation, &c. See ABLUTION, BATHS, &c.

BIELEFELDER TROPFEN—BIELEFIELDER DROPS (*Bansi*). A spirituous extract of wormwood, unripe oranges, rhubarb, cascarilla, cloves, and gentian (*Hager*).

BIEN'NIAL (bī-ĕn'-y'ăl). *Syn.* BIEN'NIS, L.; BIENNAL, BISANNUEL, DE DEUX ANS, Fr.; ZWEIJÄHRIG, Ger. Occurring once in, or lasting, two years. In *botany* and *gardening*, applied to plants that do not produce flowers and seed until the second year or season of their growth, and which then die; subst., a biennial plant.

The existence of the biennials, like that of the annuals, may be prolonged by art; indeed, many of them, by carefully removing the flowers ere the seed-vessels begin to form, may be made to bloom a second season, and even for several seasons following, like perennials. See ANNUALS, FLOWERS, PLANTS, &c.

BIFF'IN. A baked apple, flattened by pressure.

Prep. The apples are placed in a cool oven six or seven times in succession, and flattened each time by gentle pressure, gradually applied, as soon as they are soft enough to bear it; after which they are taken out, and as soon as cold put on clean dishes or glass plates. The sour or tart variety of apples is the best for baking. If the process be well managed, the appearance of the prepared fruit is very rich and the flavour delicious.

BIL'BERRY. The whortleberry.

Bilberry, Bear's. Uva ursi.

BILE. *Syn.* BI'LIS, χολή, Gr.; FEL, L.; BILE, FIEL, GALLE, Fr.; GALLE, &c., Ger. The secretion of the liver, formed by the hepatic cells, leaves the organ by the bile ducts, and when not required for the process of digestion is stored in the gall-bladder, from which a duct conveys it to the duodenum or first portion of the small intestine. Bile is a yellowish-brown or dark-green coloured transparent fluid with a sweetish, strongly bitter taste, a feeble musk-like odour, and a neutral or slightly alkaline reaction. Its sp. gr. varies in man from 1026 to 1032. It contains mucus, the bile acids (glycocholic and taurocholic) and bile pigments (bilirubin and biliverdin), also cholesterin.

Functions of the Bile. Bile plays an important part in the absorption of fats; it emulsifies neutral fats, breaking them up into minute particles, so that they are readily absorbed; it excites contractions of the muscular coats of the intestine, and thereby promotes absorption; by means of its mucus and by the increased movements of the intestine it promotes the action of the bowels, thus acting as a sort of natural purgative; it is also said to prevent putrefaction. The colouring matters of the bile are reduced and partly excreted in the fæces, giving them their natural colour, and partly in the urine as urobilin.

Bile (of Animals). See GALL.

BILE, Bil'iousness. Under these terms are popularly included all those slight affections of the stomach usually accompanied with derange-

ment of the head and bowels, apparently arising from excess of bile. Persons subject to attacks of this description should be particularly careful to avoid excess in both eating and drinking, and should more especially shun those articles of food and those liquors which, from experience, they find are apt to disagree with them. A mutton chop, slightly under-dressed, is an excellent article for the breakfast or the lunch of bilious patients; and good beef or mutton, either broiled or roasted, so that the gravy be retained, is better for dinner than many dishes apparently more delicate. These, with fresh game and venison, form a good variety from which to choose a bill of fare. New beer and porter should be particularly avoided, as well as boiled meat, stews, soups, greasy or rich puddings, much butter or fat, and most articles of pastry, as they are very indigestible, and, by overtasking the powers of the stomach, very apt to derange it. Strong cheese, salads (particularly cucumbers), over-ripe or unripe fruit, new bread and rolls, cabbages and green vegetables, and especially peas, beans, nuts, almonds, and the like, are also objectionable for persons with delicate stomachs or a bilious tendency. The bread eaten by such persons should be perfectly free from alum, and preferably prepared with meal retaining the whole of the bran in it; and should be two days, or at the least one day old. The quantity of animal food per day, except for the laborious, should be limited to from 6 or 8 to 12 *oz.;* and warm slops of all kinds, except moderately strong tea and coffee, should be taken as seldom as possible, and, in general, avoided altogether. Even cocoa and chocolate prove injurious to the delicate and bilious. Outdoor exercise and plenty of fresh air are essential to the health of such persons. Those who indulge in them freely are never attacked with affections of this kind, unless it be after gluttonising or heavy drinking. Above all things heavy and late suppers should be abandoned; indeed, the better plan is to take nothing more than a hard biscuit, or dry crust.

In general, attacks of bile may be prevented by the exercise of moderate judgment and temperance in living; and in those hitherto subject to them by the occasional use of an aloetic, mercurial, or saline aperient; and they may be generally rapidly removed by an emetic, followed by a dose of castor oil, Epsom salts, or Seidlitz powder. A tumbler of pure cold water taken on retiring to rest, and another (or even two) on rising in the morning, will often remove both the tendency and the fit, when all the usual remedies have failed. See ANTIBILIOUS, DYSPEPSIA, STOMACH AFFECTIONS, &c.

BILHARZIA HÆMATOBIA. A fluke-like parasite. It is bisexual. The body of the male is thread-shaped, round, white, and flattened anteriorly. The female is thin and delicate. This creature was discovered in the portal vein and bladder of man by Bilharz, of Cairo, after whom it was named. It is especially prevalent in those who dwell by the banks of the Nile, and is also very frequently met with amongst the inhabitants of the Cape of Good Hope. It is the cause of very serious disturbance in the human economy, and not infrequently of death.

The main symptoms of the disease this dangerous parasite sets up are those which point to derangement of the urinary organs; but its effects are not confined to these, since there seems little room to doubt that it is the chief cause of the dysentery so prevalent in Egypt, the eggs of the diatoma being found deposited within the intestinal vessels, or beneath the exudations of the swollen mucous membrane. Dr Harley has found the ova in the urine of persons affected with hæmaturia at the Cape of Good Hope. When death ensues from the presence of this parasite the post-mortem appearances are various. In the bowels, congestion, deposits upon the mucous membrane, and extensive ulcerations, degeneration and atrophy of the kidneys, dependent upon an infiltrated state of the ureters, and blocking of the portal vein, due to the presence of myriads of the parasites, are some of the most important pathological changes.

BILIARY AFFECTIONS (-yăr-e). See BILE (*antè*), CALCULI, JAUNDICE, LIVER, &c.

BI'LINE (-lĭn). *Syn.* BILI'NA, L. This name has been loosely applied to two substances: 1. Bile, or pure bile, freed from the mucus of the gall-bladder, and gently evaporated to dryness. A gummy pale yellow mass, white when powdered. 2. The mixed bile acids. See GALL, &c.

BIL'IOUS (-yŭs). *Syn.* BILIO'SUS, L.; BILIEUX, Fr.; GALLIG, GALLICHT, &c., Ger. Pertaining to, caused by, full of, or having excess of bile. See BILE, BILIOUSNESS.

BILIOUSNESS. A term which is popularly used, but generally very vaguely and incorrectly, to express various conditions which may or may not be associated with disorder of the liver, or an increased or improper secretion of bile. Dr F. T. Roberts sums up the uses of the term as follows: "In the first place it is employed to designate a peculiar temperament—*the bilious temperament.* Again, individuals are often said to be *bilious* when they present a sallow or more or less yellowish tint of skin, but especially if they are distinctly jaundiced. *Bilious vomiting and diarrhœa* signify respectively the discharge of a quantity of bile, mixed with vomited matters or with loose stools. Certain febrile diseases, attended with yellowness of the skin, are sometimes designated *bilious fever*, and under like circumstances pneumonia has been described as *bilious pneumonia.* Lastly, one of the most frequent applications of the term is to so-called *bilious attacks or biliousness,* which, however, are commonly merely attacks of acute dyspepsia or migraine. The most prominent symptoms of a supposed *bilious attack* are anorexia, furred tongue, a bitter taste, sickness, constipation, and headache, with a feeling of marked depression and general *malaise.* Such attacks are most effectually prevented by careful regulation of diet and the avoidance of exposure to cold, fatigue, and undue mental exertion or anxiety; when they come on, abstinence from food is desirable, and rest in the recumbent posture, and perfect quiet. Alterative aperients and saline effervescents may be given, alcoholic stimulants being avoided as far as possible."

BILIPH'EINE (-e-ĭn). Cholepyrrhine.

BILIV'ERDINE (-dĭn). A green colouring

matter, identical with chlorophyll, found in bile, and in the green dejections of children.

BILL OF FARE. In *cookery*, *domestic economy*, &c., a list of things ready dressed or prepared for the table (CARTE, C. D'UN RESTAURANT. MENU, &c., Fr.); also a list of articles of food in season. For Tables of the latter, see FOOD.

BILLS OF SALE. A bill of sale *for securing the repayment of money* must be in the form prescribed by the Bills of Sale Act, 1882, or it is bad. The document must be duly attested and registered within seven clear days of its execution; if executed out of England, within seven clear days of the time at which it would in the ordinary course of post arrive in England if posted immediately after the execution thereof; and shall truly set forth the consideration, otherwise it is void in respect of the personal chattels comprised therein.

BI'NARY. *Syn.* BINA″RIUS, L.; BINAIRE, Fr. Consisting of two parts. In *chemistry*, compounded of two elements, or of two bodies performing the function of elements.

BINOC'ULAR (-ū-). Having two eyes. In *optics*, of or with two eyes, as binoc'ular vi″sion; or formed with two eye-pieces or tubes, so as to be used with two eyes, as a b. mi'croscope, b. tel'escope, &c.

BIRCH. *Syn.* BE'TULA, L.; BOULEAU, Fr.; BIRKE, Ger. The common name of trees of the genus *Be'tula*; appr., *B. al'ba*, Linn., or white birch; also its wood. See BETULINE, and *below*.

Birch, Black. *Syn.* CHER'RY B., SWEET B., MOUNT'AIN MAHOG'ANY; BETULEN'TA, L. A forest tree of N. America. Wood used for cabinet work; bark yields a volatile oil similar in odour and taste to that of gaultheria; juice obtained by tapping, saccharine, and yields BIRCH SUGAR.

Birch, Paper (*Betula papyracea*, Ait.), a tree of North America. Paper can be made from the bark of this species.

Birch, White. *Syn.* BIRCH (or) COMMON B.; BE'TULA, L. A tree found in the woods of England. Wood neither very hard nor durable; leaves formerly used in itch and dropsy; bark febrifuge, yields a pyroligneous oil by distillation. The bark of the species gives the characteristic odour to Russia leather. See OILS (and *above*).

BIRCH TAR. BIRCH TAR OIL, OLEUM BETULA PYROLIGNEUM, OLEUM RUSCI PYROLIGNEUM. Under these names are sold substances of varying composition. MacEwan has pointed out that Russsian, German, and Dutch varieties are by no means uniform. They are used for currying leather. *Oleum rusci* imparts to Russia leather its peculiar odour. In *medicine*, they are employed as applications for skin diseases in treatment of psoriasis and eczema. 1 or 2 dr. to 1 oz. of lard.

BIRD. [Eng., Sax.] *Syn.* A'VIS, L.; OISEAU, Fr.; VOGEL, Ger. Any fowl or animal of the feathered kind. See BIRDS (*below*).

BIRD'LIME. *Syn.* VIS'CUS, L.; GLU, Fr.; VOGELLEIM, Ger. *Prep.* The middle bark of the holly (gathered in June or July) is boiled for six to eight hours in water, or until it becomes quite soft and tender; the water is then drained off, and it is placed in a heap, in a pit underground (commonly on layers of fern), and covered with stones. Here it is left to ferment for two or three weeks, and watered, if necessary, until it assumes a mucilaginous state. It is next pounded in a mortar until reduced to a uniform mass, which is then well kneaded with the hands in running water, until all the refuse matter is worked out. It is, lastly, placed in an earthen vessel, and covered with a little water; in which state it may be preserved from season to season, In about a week it is fit for use.

Prop. Greenish coloured; very gluey, stringy, and tenacious; when air-dried, brittle and pulverisable, but capable of gradually assuming its previous viscosity when moistened.

Uses. To cover twigs to catch birds and other small animals. It is said to be discutient, but is now never employed in medicine.

Obs. Birdlime may also be made from mistletoe berries, the young shoots of the elder, the bark of the wayfaring-tree, and some other plants, by a similar process to that above described. Should any of it stick to the hands it may be removed by means of a little oil of turpentine.

A kind of factitious birdlime is made by boiling linseed oil, either with or without a little yellow resin, until it forms a viscid, stringy paste when cold. This is chiefly used, spread on paper or cloth, to catch insects. See FLY-PAPERS, &c.

BIRDS. *Syn.* A'VES, L. Birds, besides their value as food, play an important part in the economy of organic nature, and particularly in that of the vegetable kingdom. They are the best friends of the agriculturist and the gardener; and their presence, in numbers, appears essential to keep down the innumerable races of insects that prey upon our cereals, fruits, and culinary vegetables. M. Florent Prevost, who has for fifty years presided over the Natural History Museum of Paris, and who has, like the ancient Roman augurs, examined the entrails and stomach of fowls with scientific curiosity, avers, as the result of his long experience, that birds, of whatever sort, are an unmitigated blessing to the farmer, and that the detritus and organic particles found by inspection of them in whole hecatombs, which, by the assistance of the Royal Forest Rangers, he has sacrificed on the altar of utility, show an immense preponderance of insect corpuscula in their digestive organs, whilst the traces of cereal or other valuable products are infinitesimal in comparison. It is found that even sparrows, rooks, and owls—three of the feathered tribe the most persecuted by the farmer—are, in reality, the faithful and vigilant conservators of his fruits and crops. In one of the smaller states of Germany, where, owing to public rewards being given to their destroyers, the whole race of sparrows were exterminated, the crops failed to such an alarming extent that it became necessary to offer large premiums for the reintroduction of these useful birds from other parts. In some of the agricultural districts of France, where the destruction of small birds has been carried on with relentless activity for years, insects have so prodigiously multiplied as to attack everything green around them. Even the forest trees are, in many cases, denuded of leaves by them, and are rapidly perishing. Venomous species of caterpillars, previously

scarcely known except to entomologists, have now become common; and cases of children losing their lives from attacks of them whilst bird-nesting have been published in newspapers (a striking fatal case of this description is given in the 'Times' of June 12th, 1862). In our own country the extension of sparrow clubs—associations disgraceful to the boasted intelligence of the nineteenth century—threatens similar results. Already the gardener finds his fruit crops lessening year by year; and that many of them, particularly of the smaller and sweeter fruits, have become so precarious, that they now scarcely pay for cultivation. In our own neighbourhood, where small birds have for some years been destroyed by bushels at a time, it is almost impossible to raise a currant, gooseberry, cherry, or plum; whilst seedling flowers and culinary vegetables often entirely disappear on the first night after being planted, or are so completely deprived of the succulent portion of their leaves and stems, that the remaining skeleton of network in a few days withers and dies. But this is not all—the columns of our diurnals bring us continual reports of failing grain crops in the neighbourhoods in which these bird clubs have existed for any length of time, and that even on land previously remarkable for its fertility (see the 'Times' and other leading journals for 1862). Did this loss fall only on the benighted beings who so wilfully cast back the blessings of an all-wise protecting Providence, it would be a just retribution; but, unfortunately, it affects the whole nation, and threatens, ere long, unless arrested by legislation, to prove a national calamity. The only apparent remedy for the evil, at present, is the diffusion of information tending to show that the farmer and the gardener, in destroying small birds, destroy their best friends. See BIRD (*antè*), GAME, GERMAN PASTE, NESTS (Edible), POULTRY, TAXIDERMY, TRUSSING, &c.

Birds, Colours of. The following interesting facts regarding the colours of birds appeared in the 'Standard' newspaper in 1889: The Touracos, or 'plantain eaters,' as they are popularly described, are a considerable family of birds entirely confined to Africa, where they are sometimes known to the Europeans as 'Crown birds,' from the horny base of their yellow bills being prolonged backwards over the forehead in a kind of shield. Though one or more of the species have figured in the works of ornithologists for nearly a century and a half, and of late years have received the distinction of a handsome monograph, not a great deal has been ascertained regarding their ways of life. It is known, however, that they eat fruit and frequent the highest trees in the thickest forests, seldom coming to the ground. Most of them are brilliantly hued—emerald green and dark crimson predominating. But what has more especially given the Touracos a place among birds of pre-eminent interest to the physiologist is the peculiar nature of the colouring matter which adorns the scarlet primary wing-feathers of so many of the group. In 1818 M. Jules Verreaux, a French naturalist, noticed that in the white-crested form, the 'Lory' of the Cape and Natal colonists, this beautiful hue vanished on exposure to heavy rains, and reappeared only after some interval of time, when the feathers were dry. But it has now been ascertained that this peculiarity is possessed by the crimson feathers of all the birds of the family. So completely, indeed, is the pigment soluble in cold water, that, to use the language of an eye-witness, the Touracos "wash themselves nearly white in the water left for them to drink." When a Touraco is shot in its native jungle and happens to fall into the water it not unfrequently stains the pool red with the pigment dissolved out of its wing-feathers; and it has happened more than once that when the uninitiated taxidermist proceeded to sponge the plumage of the specimen he was 'setting up,' and found that the colour came off, a fraud has been suspected of the kind with which the painted sparrows have made so many people familiar. It has been discovered by Professor Church that the crimson hue is imparted by an animal pigment peculiar to this bird, from which circumstance it has received the name of 'Touracin.' Professor Church found, on analysis, that the chief constituent of the colour is copper, a fact which renders its occurrence in the Touraco's feathers not a little remarkable. For though it is quite possible that the bird could have obtained the metal by accidentally picking it up in the soil of Africa, this explanation is not quite in accordance with the habits of a fruit feeder inhabiting dense forests, in regions which, like the Guinea Coast, are either entirely deficient in copper or possessed of it very sparingly. But Touracos bred in England, under conditions which would make it impossible for them to imbibe, even accidentally, any metallic substance, have their wing-feathers tinted with this cuprous touracin equally with their wild kindred.

Apart, however, from the chemical difficulties of the case, the use of the scarlet feathers to the bird are by no means readily understood. Coloration in an animal is always a difficult question. At one time the problem excited little attention. Beauty in the lower animals was regarded simply as an endowment, an accident as it were, into the origin and purpose of which it would be idle to inquire. But since Darwinism has set men thinking and collating one fact with another, it has been found that the most seemingly insignificant peculiarity in a species has often important influences on its life, and on its chance of surviving in that struggle for existence which lies at the bottom of all the endless speculations which the researches of late years have opened up. As yet the question is to a large extent in the region of doubt, and not unfrequently it passes the understanding of the zoologist to say what precise advantage certain gaudy hues are to certain species. For instance, though the usual explanation of peculiarities of coloration is that they enable animals liable to be attacked by powerful enemies to 'mimic' others less prone to persecution, and thus to escape, it is by no means made out that the gaudy hues of some fishes have their *raison d'être* in that object. The 'fatal gift of beauty' seems, indeed, sometimes to point them out as proper subjects for preying upon. Nor does it appear that the bright-hued ones are, in other instances, always avoided and the sober-skinned ones attacked. There are, at the same

time, exceptions; for all the remarkable discoveries of recent years prove that no form, no colouring, no pattern is meaningless or useless. Lovely tints, ornamentation, and plumage may be fair to the eye; but that is not all their use. We are certain, though we may not know their full value, that they are not simply a beauty of nature; they are features of the great unfolding scheme of life. Gaudily-striped bees and wasps have stings, and are therefore saved from the perils created by their own conspicuousness. The colour of a great many animals evidently serves to conceal them either in the depths of the forest or in the open plain. Thus, in the Arctic regions animals cast the russet coat of summer for the snowy one of winter, and some peculiarly Alpine species undergo similar changes. The ermine, the hare, and the Polar fox are examples, while the ice-bear, which is supreme in the northern waters, and, therefore, does not require a protection of that kind, by being white is enabled more easily to approach its prey. Several birds, like the ptarmigan, also change their plumage, and the young of seals are born with white pelts, which they change for darker ones as soon as they are capable of living independently of their mother. On the other hand, the summer feathers of the ptarmigan are well adapted for a bird roosting on lichen-covered rocks, while the heather-hued plumage of the grouse, like the similar coat of the partridge, is equally favourable to their escaping the notice of ruthless enemies.

In like manner, the green-hued feathers of many tropical birds, or the green skins of lizards and tree frogs, enable them to prolong their days in umbrageous woods full of lurking enemies, just as the dusky colouring of night-haunting species and the bamboo-like stripes of the tiger enable them, without detection, to stalk prey which would otherwise flee before them. In sandy deserts, like the Sahara, the skin of all the snakes and lizards, and the exterior of nearly all the insects, approximate in colour to that of the soil. Serpents and other animals are often so like the vegetation among which they creep that an inexperienced eye does not readily distinguish the one from the other, while it is one of the most remarkable of all the discoveries to which Mr Darwin's teachings have given rise, that many species which are harmless in themselves (and therefore in parlous case from voracious enemies) 'mimic,' as the phrase is—though the word does not exactly represent the actual conditions—those creatures which are avoided by reason of their venomous nature, their pungent odours, or similar objectionable qualities. Thus the aard-wolf of Africa, which has weak jaws and feeds on ants and carrion, is spotted exactly like the savage hyena. Again, there are many innocuous snakes of Brazil which closely imitate the appearance of the deadly reptiles with which they associate. It has also been noticed by Mr Wallace that there are several birds which adopt a similar ruse, or, in the process of 'natural selection,' have had it forced upon them, for avoiding the attention of their enemies, and so, in the weary, never-ending struggle for existence, escaping extermination. Can it be that this is the secret of the Touraco dropping on occasion the gaudy crimson tints of its wing-feathers, which, in the depth of an African jungle, would, one might imagine, make it the observed of unwelcome observers in that part of the world? It is possible—for we do not know—that, after heavy tropical rains, some animal, some bird of prey, or tree snake it may be, which during the dry season is less numerous, or less active, or lies *perdu*, appears in the woods haunted by the Touraco, when kindly Nature, by the contrivance of making the gaudy pigment 'washable,' enables it for a time to suppress its most conspicuous feature.

BIS'COTIN. [Fr.] A small biscuit. In *cookery*, &c., a species of confection made of eggs, flour, marmalade, and sugar, variously compounded and flavoured according to the taste of the operator.

BIS'CUIT (-kĭt). [Eng., Fr.] *Syn.* BUCELLA'TUM, PA'NIS BIS COC'TUS, L.; SWIEBACK, Ger.; BISCOTTO, It.; BIZCOCHO, Sp. Literally, 'twice-baked'; appr., a well-known variety of hard, dry, unleavened bread, made in thin, flat pieces. Those prepared for seamen (SEA' BISCUITS, CAP'TAIN'S B.) (a captain's biscuit differs from a common 'sea biscuit' in being made of finer flour) are composed of flour and water only. When made of fine flour, and a few caraway seeds are added, they are commonly called ABERNE'THY BISCUITS. Fancy biscuits generally contain a little sugar and butter, to which almonds, caraways, mace, ginger, lemon, and other articles, technically called 'flavourings,' are frequently added.

Prep. On the small scale, biscuits are made by forming the flour and water into a dough by the common process of hand-kneading, occasionally assisted with a lever, as in making ordinary bread. The dough is then rolled into a sheet, and cut into pieces of the desired size and form. These, after being stamped, are exposed to the heat of a moderately quick oven, when a few minutes (12 to 18, according to their size) are sufficient to bake them.

On the large scale, the whole manual process, from preparing the dough to the point at which the newly-made biscuits are ready for baking is now generally performed by machinery. The articles so prepared are commonly known in trade as 'MACHINE-MADE BISCUITS,' and are not only much cheaper, but of fully equal quality to those 'made by hand.' In the bakehouses of her Majesty's Victualling Yards at Deptford, Gosport, and Plymouth, the ingenious machinery invented by Mr T. T. Grant is employed. These establishments are said to be capable of producing annually above 8000 tons of sea biscuits, at a saving of upwards of £12,000 a year, from the cost that would have been incurred for the purpose on the old system. Under the latter it is stated that wages and wear and tear of utensils cost about 1*s.* 6*d.* per cwt. of biscuit; whilst under the new system the cost is only 5*d.*

The allowance of biscuit to each seaman in the Royal Navy is 1 *lb.* per day; or, on the average, six biscuits.

Biscuits Depuratifs (*Olivier*) are made with meal, milk, and sugar. Each biscuit contains 1 centigr. corrosive sublimate (*Foy*).

Biscuits, Fancy. The varieties of these are

almost innumerable. In a printed list now before us we observe the names of upwards of one hundred different kinds. These are produced by varying the number and proportions of the ingredients used in their composition, and the form and size in which they are turned out of hand. They are further modified by the relative heat of the oven, as well as the length of time they are allowed to remain in it. It would, therefore, be waste of space to give particular directions for the preparation of each. The proportion of butter and sugar, or either of them, may be from 1 *oz.* and upwards, to flour, 1 *lb.*, according to the degree of richness desired. In a few cases milk, or eggs, or both, are introduced. The 'flavourings' embrace a wide range of substances—bitter almonds, caraways, cassia, cinnamon, ginger, mace, nutmeg, lemon, orange-peel, orange-flower water, essence of peach kernels, vanilla, &c., many of which give their name to the biscuit. AR′ROWROOT BISCUITS are usually made of equal parts of arrowroot and flour; MEAT′-BISCUITS, from about 1 part of lean meat (minced small and pulped) beaten to a dough with about 2 parts of flour and a little seasoning, no water being added (for the MEAT-BISCUITS used in the navy and by travellers, see MEAT); SODA BISCUITS, by adding 1 to 2 *dr.* of carbonate of soda to each 1 *lb.* of flour. In most other cases the mere inspection of the biscuit will convey to the experienced biscuit-baker and cook sufficient information to enable him to produce an exactly similar one, or at least a very close imitation. The richest kind of SPONGE-BISCUITS, as we are informed, are made as follows: Add the whites and yelks of 12 eggs, previously well beaten, to $1\frac{1}{2}$ *lb.* of finely powdered sugar, and whisk it until it rises in bubbles, then add 1 *lb.* of the finest pastry-flour and the grated rind of two lemons. Put it into 'shapes,' sift a little sugar over them, and bake them in buttered tin moulds, in a moderately quick oven, for nearly half an hour. A few fancy biscuits will be found noticed in their alphabetical places. See CRACKNELS, MACAROONS, GLUTEN, &c.

Biscuits Purgatifs (*Caroz*). Each biscuit contains 2 decigrms. scammony (*Reveil*).

Biscuits Purgatifs (*Sulot*). Each biscuit contains 6 decigrms. scammony.

Biscuits Purgatifs et Vermifuges (*Ferd. Gräf*, Aschbach) contains $\frac{1}{4}$ grm. resina scammonii in each.

Biscuits Purgatifs et Vermifuges au Calomel (*Sulot*). There are 3 decigrms. of calomel in each (*Reveil*).

Biscuits Vermifuges à la Santonine (*Sulot*). Each biscuit contains 5 centigrms. of santonin (*Reveil*).

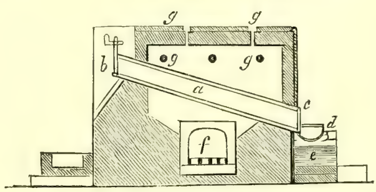
BISCUITS, DEV′ILED, in *cookery*, are captain's biscuits (or any similar kind) buttered on both sides, peppered well, and then covered on one side with a slice of good cheese formed into a paste with made mustard; the whole being seasoned with a little cayenne pepper is, lastly, grilled. Chopped anchovies, or essence of anchovies, is a good addition.

BISH ROOT or **BIKH ROOT.** ACONITUM FEROX, q. v.

BISMUTH. Symbol Bi; Atomic Weight = 208. BISMUTH, ETAIN DE GLACE, Fr.; WISMUTH, W.-METALL, Ger. A metallic element belonging to the same group as nitrogen, phosphorus, arsenic, and antimony, but more decidedly metallic in its properties than any one of those. Of the above-mentioned elements it resembles antimony the most.

Sources. NATIVE BISMUTH occurs uncombined with other elements in Saxony and other parts of Germany, Cumberland and Cornwall in England, Norway, Spain, California, Bolivia, and New South Wales. The oxide (BISMUTH OCHRE, Bi_2O_3) and sulphide (BISMUTHITE, Bi_2S_3) also occur in the same districts. Nearly three fourths of the bismuth used in commerce comes from Saxony.

Prep. It is extracted chiefly at Schneeberg, in Saxony, by the process of eliquation, from an ore containing 7% to 12% of metallic bismuth, associated with a compound of arsenic and cobalt. The ore is broken up into pieces of about the size of a nut, and heated in sloping cast-iron cylinders (see *engr.*). From these the liquefied metal runs



Bismuth furnace in section.
a, Eliquation-tube.
b, End at which it is charged.
c, End from which the metal flows.
d, Receiving-pan.
e, Water-trough,
f, Grate, &c.
g, *g*, Draught-holes.

into heated iron pots containing a little coal dust, to prevent oxidation of the bismuth; these pots are then emptied into moulds, in which the metal is cast into bars weighing from 25 to 50 lbs. each.

This process was at one time generally used, but it has now been superseded by the following one: The ore is roasted and smelted in pots with iron, carbon, and slag; two layers are thus formed, an upper of cobalt-speiss, and a lower of almost pure bismuth, the latter of which, owing to its low melting point, can be drawn off in the liquid state after the upper layer of speiss has solidified. The crude bismuth thus prepared contains small traces only of iron, cobalt, nickel, lead, silver, sulphur, and arsenic, and is purified by heating it on a slightly inclined iron plate, so that the bismuth melts and runs down. Almost chemically pure refined bismuth is thus obtained. Pure bismuth may also be made by heating a mixture of the oxide or subnitrate with charcoal to redness in a covered crucible.

Bismuth, Purified. BISMUTHUM PURIFICATUM, L. (Ph. B.) Heat 10 *oz.* bismuth with a mixture of $\frac{1}{2}$ *oz.* potassium cyanide and 80 gr. sulphur to redness in a crucible for about 15 minutes, stirring constantly. Allow the contents to cool till the flux has solidified to a crust, make two holes in this crust, and pour out the still liquid bismuth into another crucible. Remelt this with about 5% of a mixture of equal parts of dried sodium

and potassium carbonates, heating to bright redness and constantly stirring. Allow the contents of the crucible to cool, and pour out the bismuth into suitable moulds.

Prop. A very lustrous metal, white with a reddish tinge, hard, brittle, and crystalline; the crystals are rhombohedral, but are with difficulty distinguished from cubes. It melts at 268° C. (515° F.), and distils at a high temperature. It expands by $\frac{1}{760}$ of its length when heated from 0°—100° C. (32°—212° F.), and it expands on solidifying; its sp. gr. is 9·759, this being *decreased* by pressure. The metal oxidises slowly in the air, and burns at a higher temperature; it dissolves readily in cold nitric acid or *aqua regia* and is also soluble in hot sulphuric acid. Bismuth is highly diamagnetic.

Uses. Many of the alloys of bismuth melt at very low temperature, and, like bismuth itself, expand on solidifying; they are consequently much used for taking casts, as in stereotyping, copying woodcuts, &c. The composition of some varieties of *fusible metal* is given below:

	Newton's Metal.	Rose's Metal.	Wood's Metal.
Bismuth	8	2	4
Lead	5	1	2
Tin	3	1	1
Cadmium	—	—	1
Melting point, C.	94·5°	93·75°	60·5°
" " F.	202°	201°	141°

Other alloys of higher melting points are used as solders and also as baths in which to heat steel to known temperatures in the process of tempering.

Tests for. Solutions of bismuth salts may be recognised by the following tests: 1. They give with sulphuretted hydrogen a black precipitate of sulphide insoluble in ammonium sulphide, but soluble in nitric acid, from which solution the bismuth is not precipitated by sulphuric acid, as happens in the case of lead. 2. When their solutions (if they be not excessively acid) are diluted with water, white precipitates of basic salts are formed, soluble in excess of acid. This reaction is most marked in the case of the chloride. 3. Potassium bichromate gives a yellow precipitate of chromate, which, unlike lead chromate, is soluble in dilute nitric acid, and insoluble in potash.

Estimation. 1. The solution, which must not contain sulphuric or hydrochloric acid, is heated for some time with excess of ammonium carbonate, when basic bismuth carbonate is precipitated; this is collected and dried, and converted by ignition into the oxide (Bi_2O_3), in which state it is weighed. 2. The bismuth is precipitated as sulphide by sulphuretted hydrogen in a slightly acid solution; the black precipitate is collected on a weighed filter, dried at 100° C., and weighed. Other methods are—3, to precipitate the bismuth in a nearly neutral solution as a chromate or arseniate, and weigh the precipitate, after drying it at 120° C.; 4, to reduce the salt to the metal by fusion with potassium cyanide, and weigh this, after washing it with water and alcohol.

Oxides of. Four are known, viz. Bi_2O_2, Bi_2O_3, Bi_2O_4, and Bi_2O_5. Only the second and fourth of these are important.

Bismuthous Oxide, Bi_2O_3. *Syn.* TEROXIDE OF BISMUTH, PROTOXIDE OF B. *Prep.* By igniting bismuth oxynitrate till no more nitrous fumes are evolved. It is a yellow powder, difficultly soluble. It occurs native as BISMUTH OCHRE in Cornwall, Virginia, the Erzgebirge in Germany, and Siberia.

THE HYDRATED OXIDE. *Prep.* By gradually dropping an acid solution of bismuth nitrate into a concentrated solution of potassium hydrate, free from carbonate, and washing and drying the resulting precipitate.

Prop., &c. The oxide fuses at a high temperature, and then acts as a powerful flux on siliceous matter, without itself imparting any colour. It has, therefore, been used in enamelling and gilding. It has also been employed to replace lead oxide in flint glass. Like the basic nitrate, it has been used as an antispasmodic and as a cosmetic. Sp. gr. = 8·21.

Bismuthic Oxide, Bi_2O_5. *Syn.* BISMUTHIC ANHYDRIDE, BISMUTHIC ACID. *Prep.* By suspending teroxide of bismuth in a strong solution of potash, and passing chlorine through the mixture till the decomposition is complete. The resulting powder is treated with dilute nitric acid (to remove any undecomposed teroxide), washed with cold water, and dried.

Prop., &c. A reddish powder, soluble in water. With bases it forms salts (*bismuthates*), which are but little known. When heated it loses oxygen and forms the tetroxide, Bi_2O_4.

Salts of. These are nearly all colourless; they are soluble in acids, but are decomposed by excess of water, insoluble basic salts and some free acid being formed.

Bismuth, Carbonate of. *Bismuthi carbonas* (Ph. B.). Mix 4 fl. oz. of nitric acid (of 1·42 sp. gr.) with 3 *oz.* of distilled water, and add 2 *oz.* of purified bismuth in successive small portions. After the effervescence has ceased, boil the solution for 10 minutes, and decant it from any insoluble matter. Evaporate to 2 fl. oz., and add this gradually to a cold filtered solution of 6 *oz.* of ammonium carbonate in 2 pints of distilled water, stirring continuously. Collect the precipitate on a calico filter, and wash with distilled water till the washings are tasteless. Squeeze out some of the water with the hands, and dry at a temperature not exceeding 65·5° C. (150° F.). The substance thus obtained is a basic carbonate of bismuth.—*Dose,* 5 to 20 gr.

Bismuth, Citrate of. *Bismuthi citras* (Ph. B.). Heat 5½ *oz.* of bismuth subnitrate with 11 fl. oz. of nitric acid (of 1·42 sp. gr.) till the salt is dissolved. Add water, constantly stirring, till the cloudiness produced by the water no longer rapidly disappears. Now dissolve 8 *oz.* of bicarbonate of soda in distilled water, add to this 4 *oz.* of citric acid, boil till all gas is expelled, and then add the resulting liquid to the clear or faintly opalescent solution of bismuth till no further precipitate is produced. Heat the solution to boiling, and set it aside to cool. When cold, filter and wash the precipitated bismuth citrate till no free nitric acid remains, and then dry it over a water-bath. This salt, dissolved in solution of ammonia and water, forms the 'Liquor Bismuthi' of the Pharmacopœia.

Bismuth, Chloride of, $BiCl_3$. *Syn.* TERCHLOR-

IDE OF BISMUTH. *Prep.* 1. By heating 1 part powdered bismuth with 2 parts corrosive sublimate till all the mercury is expelled. Or, 2, by heating bismuth in a current of chlorine. A granular white mass, easily fusible and very deliquescent; it is decomposed by water, white oxychloride being precipitated.

Bismuth, Oxychloride of, BiOCl. *Syn.* SUBCHLORIDE OF BISMUTH, BASIC CHLORIDE OF B., PEARL POWDER; BISMUTHI SUBCHLORIDUM, L. *Prep.* By dissolving bismuth in nitric acid, adding dilute hydrochloric acid to the solution, and washing and drying the resulting precipitate.—*Prop., Uses, &c.* Similar to those of the subnitrate.

Bismuth, Nitrate of, $Bi(NO_3)_3$. *Syn.* NEUTRAL NITRATE OF BISMUTH, TERNITRATE OF B. *Prep.* Dissolve bismuth in nitric acid, filter the solution through asbestos or powdered glass, evaporate it to small bulk, and allow it to crystallise. The crystals are deliquescent, and decompose on heating, giving first the subnitrate and then the oxide; they are decomposed by water, insoluble subnitrate being formed.

Bismuth, Oxynitrate of, $BiONO_3$. *Syn.* SUBNITRATE OF BISMUTH, BASIC NITRATE OF B., PEARL-WHITE; BISMUTHI SUBNITRAS, B. NITRAS, L.; DE BLANC FARD, B. D'ESPAGNE, &c., Fr.; PERLWEISS, SCHMINKWEISS, Ger. *Prep.* (Ph. B.). Mix 4 fl. oz. of nitric acid (of 1·42 sp. gr.) with 3 *oz.* of distilled water, and add 2 *oz.* of purified bismuth in successive small portions. When the effervescence has ceased boil the solution for 10 minutes, decant it from any insoluble matter, evaporate it to 2 fl. oz., and pour it into ½ gall. of distilled water. Allow the precipitate to subside, decant off the supernatant liquid, add ½ gall. distilled water to the precipitate; stir them well together, and after 2 hours decant off the liquid. Collect the precipitate on a calico filter, squeeze out the water from it, and dry it at a temperature not exceeding 65·5° C. (150° F.).

Prop. A pearly-white inodorous powder consisting of very fine microscopic crystalline laminæ, insoluble in water, but soluble in nitric acid; long exposure to light turns it greyish. When moistened it gives an acid reaction with litmus paper.

Pois., &c. Like the other salts of bismuth, it causes vomiting, purging, giddiness, cramp, insensibility, &c. No certain antidote is known. The treatment may consist of an emetic, followed by the copious use of emollient drinks, as weak broth, barley water, milk and water, &c.; and subsequently, when necessary to prevent inflammation, by a low diet and aperients.

Uses, &c. In *medicine,* bismuth salts are sedative, astringent or tonic, and antispasmodic; used in chronic affections of the stomach, unaccompanied by organic disease of that organ, and apparently of a nervous character; particularly in gastrodynia, troublesome sickness and vomiting, pyrosis or waterbrash, diarrhœa, and generally in gastro-intestinal affections attended with fluxes; also in intermittent fever, spasmodic asthma, &c. —*Dose,* 5 to 10, or even 20 gr.

Externally, made into an ointment with 4 parts of lard, it has long been employed in certain chronic skin diseases. Under the name of PEARL-WHITE the subnitrate is commonly used by ladies as a cosmetic; but it is stated that it injures the skin, producing, after a time, paralysis of its minute vessels, rendering it yellow and leather-like—an effect which, unfortunately, it is usually attempted to conceal by its freer and more frequent application. In very large doses it is poisonous.

Both the basic nitrate and the basic chloride of bismuth pass under the names of PEARL-WHITE and PEARL-POWDER, owing to their extreme whiteness and beauty. That of the druggists, however, is usually the former; that of the perfumers usually the latter, but not unfrequently both.

Bismuthous Sulphide, Bi_2S_3. *Prep.* 1. By fusing together bismuth and sulphur. 2. By precipitating a solution of a bismuth salt with sulphuretted hydrogen. It occurs native as BISMUTHITE in Cumberland, Cornwall, the Erzgebirge, and Bolivia.

Bismuthous Valerate. *Syn.* BISMU'THI VALERIA'NAS, L. *Prep.* An acid solution of nitrate of bismuth is decomposed with a solution of valerate of soda in water containing a little free valerianic acid; the precipitate is carefully washed with distilled water, and dried in the shade. Recommended as superior to the subnitrate in some forms of gastrodynia, dyspepsia, intermittents, &c. —*Dose,* 2 to 6 gr., or more.

Bismuth Powder. For beautifying the skin and removing freckles (from North America). Consists of calcium carbonate, with much clay, and is free from injurious metals (*Chandler*).

BISTRE (-ter). [Eng., Fr.] *Syn.* BISTER, Ger. *Prep.* 1. The most compact, best coloured, and well-burnt portions of the soot of beechwood, or of peat, are selected, reduced to powder, and sifted through a very fine lawn sieve. It is then digested in clear warm water for several hours, with frequent stirring; after which it is allowed to settle, when the liquid portion is decanted from the sediment. This process is repeated a second and even a third time. The paste is next poured into a tall narrow vessel, which is then filled with pure cold water and well agitated. The grosser parts only are now allowed to subside, and the supernatant liquor, containing the finer portion of the BISTRE in suspension, is poured off into another vessel, where it is left to deposit its contents. The deposit is next collected, and carefully dried and powdered; or it is only partially dried, and at once made into cakes with gum-water or isinglass size, and then allowed to dry and harden for sale.

2. (*Dr MacCulloch.*) The tar-like liquid obtained from the dry distillation of wood is again carefully distilled until all volatile matter has passed over, and a brittle, pitch-like residuum is obtained, which is either brown or black, according to the time and temperature employed; after which the heat is still further prolonged, but with increased care, until the brittle substance becomes pulverulent and carbonaceous. It is then ground and elutriated with pure cold water, as before.

Uses, &c. As a water-colour to tint drawings, in the same way as Indian ink, to which it is esteemed superior when the subjects are intended to be afterwards tinted with other colours. It

occupies the same place among water-colours that brown-pink does in oil.

According to Dr MacCulloch, bistre from wood-tar, when carefully prepared, has great depth and beauty of colour, with all the fine properties of sepia; but if the whole of the oils and acids have not been removed by the process, it is apt to collect in little flocks which interfere with its use.

BITES AND STINGS. In the treatment of bites and stings, using the words in their common sense, we have to deal with the bites of domestic animals, vermin, and snakes, and with the bites or stings or punctures produced by insects, and finally with the wounds produced by the special organs of certain plants. In treating of bites by animals we must distinguish between those which produce mere lacerated wounds, and as such purely surgical injuries, and the bites of rabid animals and of snakes which, in addition to the surgical injuries produced, set up a train of symptoms requiring more or less special treatment.

Bites of Rabid Animals. It is generally supposed that the application of the actual cautery or the use of some powerful caustic, such as nitric acid, to the wounds caused by the bites of rabid animals, is necessary. The value of this treatment, which is somewhat cruel unless anæsthetics are used, is a little doubtful, and when it is considered that the poison is upon the animal's teeth in the saliva (supposing the bite to have been on the bare skin and not through clothing) it will be readily understood that a portion of it at least will be at once thrown into the circulation—all that can be hoped is the destruction of that which is left upon the surface of the wound; nevertheless, if the treatment be immediate, there is some ground for believing that the cautery is useful. The following method should be adopted in the case of a bite by a rabid or supposed rabid animal:

Arrest the circulation at once by means of a ligature (see BLEEDING) tightly applied above the wound. If a bandage be not at hand, the object may be attained by compressing the main artery with the finger and thumb until assistance can be obtained and a proper ligature applied, the object being to arrest the circulation at once if possible. Next wash the wound and allow it to bleed freely; then if there should be no cuts or sores about the mouth of the operator he should, after rinsing his mouth with water, or, better still, with vinegar and water, suck the wound several times. This is supposed to be a dangerous proceeding, but experience shows that it is not. As soon as this is done the wound should be cauterised with nitrate of silver, or, if much time has elapsed, with nitric acid or concentrated carbolic acid; free excision of the bite may be performed, and it is perhaps desirable. From what has been said above, the hope of preventing inoculation is perhaps not very great; but, considering the terrible nature of the disease which results, it is well to use these methods, although we may not be certain of their efficacy.

Simple Bites. The effects of a simple bite are, as a rule, to produce a contused and frequently a lacerated wound which will vary in size, and in the amount of injury inflicted, with the size of the animal causing it. For example, the bite of a rodent, such as a rat, may be deep and penetrating; that of a cat may extend to a considerable depth, and in addition is generally much lacerated and the skin almost destroyed, producing a wound which is difficult to heal and which is apt to leave an ugly scar.

The bites of monkeys are also somewhat of this nature, whilst those of horses and large dogs involve a considerable area of skin and flesh which is, in addition to the cutting produced by the teeth of the animals, crushed and contused by the power of the jaws. In all these cases the first thing to be done is to thoroughly wash the wound with water containing some simple antiseptic, such as carbolic or boracic acid, and to remove, if possible, all traces of dirt or other matter which may have been carried into it; this washing should be thorough. It is not advisable always to remove small scraps of skin which appear to be hanging from a lacerated wound, as there is always a hope that they may form the centres of fresh growths, and thus diminish the unsightliness of the scar. This done, a piece of lint soaked in carbolised water or oil, or in a solution of boracic acid, should be carefully laid over the wound, a piece of dry lint placed over this, and then a piece of oil-silk or other impervious material, and the whole kept in its place by a bandage. These simple dressings should be changed at least once in every twenty-four hours, and the most scrupulous cleanliness observed. The injured part should be kept at rest by means of a sling, splint, or other suitable contrivance.

Snake Bites. Snake bites are more or less dangerous according to the species of snake which inflicts them; and, given that the species be the same, according to whether the climate be hot or cold, *i. e.* the bite of a viper in England would be less serious than a bite from a viper in Spain or Italy. The bite of the common English viper, though by no means to be neglected, is very rarely fatal; we may almost say never, except in the case of infants and aged or debilitated persons. From the nature of the bite and the structure of the instrument which inflicts it, the inoculation is almost perfect. The same methods should be adopted as in the case of the bite of a rabid animal, but the after-treatment is more urgent; the strength has to be supported by stimulants, such as alcohol and ammonia; and it may, in the case of bite by some of the more venomous tropical snakes, be necessary to resort to artificial respiration (see DROWNING). The elimination of the poison from the system should be promoted by the use of stimulating diuretics; the patient should be kept warm and quiet; injection of ammonia into the veins is believed to be one of the best remedies in very grave cases. It must be remembered, in dealing with snake bites, that the number of poisonous snakes is limited, and that a large number of snakes whose bite *may* cause death, like the English viper, frequently fail to do so; nevertheless, in countries where peculiarly venomous snakes are found, the greatest care should be taken in the case of *any* snake bite. Many snakes are harmless, but have teeth capable of inflicting a wound under exceptional circumstances.

Stings. The term sting is very loosely used,

and may be applied to any punctured wound caused by an invertebrate animal. The so-called sting of a snake is a misnomer, as it is a true bite. The stings or punctures inflicted by centipedes and scorpions are produced by puncturing the skin with an apparatus specially provided and supplied with poison. The bites of scorpions are only dangerous to life in very hot countries; the treatment is somewhat similar to that of snake bite combined with the local application of vinegar, ammonia, and the like; stimulants and sometimes opiates are serviceable.

Stings and Bites of Insects. The common flea, in some persons, produces great irritation and even swelling by its bite; this can be readily allayed by simple local applications, and is never of consequence.

Gnats, Mosquitoes, Gadflies, &c., produce small poisoned wounds, which are excessively irritating, and may even be dangerous. The *Tsetse* (*Glossina morsitans*), a native of Africa, is capable of killing a horse, ox, or dog; but its bite causes nothing more than slight irritation in man. The pain caused by the bite of most of these insects may be allayed by the local application of salt, ammonia, soda, oil, &c. As regards mosquitoes, gnats, and other dipterous insects, it may be said that tobacco-smoke and the odour of certain essential oils is repugnant to them, and the annoyance caused by them can to a very considerable extent be diminished by rubbing the exposed parts of the body with vaseline strongly scented with thymol, oil of cloves, bergamot, &c.

Bees and Wasps. Local applications such as those recommended above are useful, but the sting should be carefully removed from the wound. In cases in which the sting is in the mouth or throat, as may sometimes happen from eating fruit in which a wasp or bee is hidden, grave consequences may result, and it may be necessary to resort to extreme surgical measures in order to prevent the death of the patient from suffocation. Emetics are then sometimes useful. Some further information will be found under VENOMOUS ANIMALS. The treatment of the stings of plants is as a rule local, and the same remedies will be found useful as for the stings of insects.

BITT′ER. [Eng., Ger.] *Syn.* AMA″RUS, L.; AMER, Fr. Tasting like wormwood, quassia, or other similar vegetables; subst., a bitter plant, bark, or root (=AMA″RUM, L.; see *below*).

Bitter Almonds, Oil of. See BENZOIC ALDEHYDE.

Bitter App′le‡. Colocynth.

Bitter Bark (*Petalostigma quadriloculare,* F. Muell.), introduced from Australia as a substitute for cinchona.

Bitter Cup. A cup or tumbler formed by the turner out of quassia wood. Water, by standing in it a short time, becomes bitter and stomachic. They are now common in the shops.

Bitter Earth*. Magnesia.

Bitter Herbs. See BITTERS (*infrà*) and SPECIES (Bitter).

Bitter Salt†, Bitter Pur″ging-salt. Sulphate of magnesium.

Bitt′erwort‡ (-wŭrt). Gentian.

BITT′ERN. The 'mother-water' or 'bitter liquor' of salt-works from which the chloride of sodium (sea-salt) has been separated by crystallisation.

Bittern. An intoxicating poisonous mixture sold by the brewers' druggist, composed of 1 part each of extract of quassia and powdered sulphate of iron, with 2 parts of extract of cocculus indicus, 4 parts of Spanish liquorice, and about 8 parts of treacle; the liquorice being first boiled with a little water until dissolved, and the solution evaporated to a proper consistence before adding the other ingredients. Used by fraudulent brewers and publicans to impart a false bitter and apparent strength to their liquors.

BITT′ERS (-ĕrz). *Syn.* AMA″RA, &c., L. Vegetable bitters are commonly regarded as tonic and stomachic, and to improve the appetite when taken occasionally and in moderation. The best time is early in the morning, or half an hour or an hour before a meal. An excessive or a too prolonged use of them tends to weaken the stomach and induce nervousness. They should not be taken for a longer period than about 8 or 10 days at a time, allowing a similar period to elapse before again having recourse to them.

Among the most useful and generally employed bitters are—calumba, cascarilla, chamomiles, gentian, hops, orange-peel, quassia, and wormwood.

Bitters. In the liquor trade, a compound prepared by steeping vegetable bitters, and some aromatics as flavouring, in weak spirit, for some 8 or 10 days; a little sugar or syrup being subsequently added to the strained or decanted tincture. In that of the taverns and gin-shops the menstruum is usually gin, or plain spirit reduced to a corresponding strength. Rue gin is a preparation of this class. BRAN′DY-BITTERS and WINE′-BITTERS are prepared in a similar way with common British brandy, or some cheap white wine (Cape or raisin), as the case may be. Each maker has usually his own formulæ, which he modifies to suit the price and the palate of his customer. This class of liquors has been justly charged with being the fertile cause of habitual intemperance, of disease, and even of death! Their occasional use as tonics or stomachics is also objectionable, owing to the trash, and even deleterious substances, which so frequently enter into their composition. See LIQUEURS.

Bitter-sweet, or woody nightshade. *Solanum dulcamara,* L. A common hedge plant in England.

BITUMEN. [Eng., L.] *Syn.* BITUME, Fr.; ERDPECH, ERDTHEER, &c., Ger. See ASPHALTE.

Bitumen, Elastic. *Syn.* MIN′ERAL CAOU′TCHOUC (kōō′-chōōk), EL′ATERITE. A rather rare species of bitumen, differing chiefly from the other solid varieties in being elastic.

Bitumen, Liq′uid. Petroleum.

BITU′MINOUS. *Syn.* BITUMĪNO′SUS, L.; BITUMINEUX, Fr.; ERDPECHIG, Ger. Of bitumen, or resembling or containing it.

BIXIN. A colouring matter contained in annatto seeds (BIXA ORELLANA, L.; ORLEAN, Fr. and Ger.). Much confusion exists among those who have investigated this substance. Bolley and Mylius prepared a red colouring matter by washing the seeds with water, drying the residue, extracting it with hot alcohol, and then filtering

this extract, evaporating off the alcohol, and extracting the residue with ether. Stein also obtained a red colouring matter by repeatedly extracting annatto seeds with water, filtering the aqueous solution, evaporating off the water, and washing the residue repeatedly with petroleum and with ether, in order to remove vegetable fat. This red colouring matter is soluble in alcohol and in a solution of sodium carbonate, but only very slightly soluble in water. Preisser obtained a *yellowish-white* colouring matter by extracting annatto seeds with a dilute solution of sodium carbonate, precipitating the colouring matter with lead oxide, decomposing the lead compound with sulphuretted hydrogen, and quickly evaporating the solution. He thus obtained small white crystals, to which he gave the name of BIXIN; when these were treated with ammonia in the presence of air, a red substance was formed, which he named BIXEIN.

BLACK. *Syn.* A'TER, NI'GER, L.; NOIR, Fr.; SCHWARZ, Ger.; BLAC, BLÆC, Sax.

Black Ash. See SODA, MANUFACTURE OF.

Black Draught. See MIXTURE, SENNA (Compound).

Black Drop. See DROPS, PATENT MEDICINES, &c.

BLACKBOARD COATING. 1. Take of sandarach, 300 grms.; shellac, 300 grms.; lamp-black, 200 grms.; ultramarine, 30 grms.; ether, 10 grms.; (94% alcohol), 4 litres.

2. Shellac, 200 grms.; camphor, 80 grms.; lamp-black, 90 grms.; ether, 800 grms.; alcohol, 1000 grms.

BLACK COHOSH, BLACK SNAKE ROOT, or **BUGBANE** (*Cimicifuga racemosa*, Elliott). A perennial herb common in the United States and Canada. The rootstocks are bitter, slightly acrid, and astringent, and are used in medicine in North America. See CIMICIFUGA.

BLACK DYE. *Syn.* TEINTE NOIRE, Fr.; SCHWARZE FARBE, Ger. (This article is taken mainly from Hummel's 'Dyeing of Textile Fabrics.') There are only two methods in general practice for producing black dyes, viz. by means of logwood, using iron or chromium as a mordant, and by means of aniline black. See LOGWOOD BLACKS.

Application to Cotton. Mordanting. One of the following three methods may be used:—1. Work the cotton in a cold solution of pyrolignite or nitrate of iron (see MORDANTS, IRON) at about 5° Tw. (1·025 sp. gr.) till it is thoroughly saturated; then squeeze and work in weak bath of sodium carbonate or milk of lime, and wash thoroughly.

2. Work the cotton in a cold infusion of 30% to 40% of sumach, and allow to steep for several hours; squeeze out the excess of liquor, and work for half an hour in a cold solution of nitrate or pyrolignite of iron at 2°—4° Tw. (1·01 to 1·02 sp. gr.), and wash well. A lime-bath may be applied with advantage before washing, in order to remove any trace of acid.

3. The pyrolignite as above (method 2) is mixed with an equal volume of aluminium acetate (red liquor) at 5° Tw. (1·025 sp. gr.), the cotton being afterwards worked at 50°—60° C. (112°—140° F.) for a quarter of an hour in a dilute solution of phosphate or arsenate of soda. The use of aluminium salt as a mordant together with the iron one prevents the reddish appearance which is frequently produced when iron alone is employed.

Dyeing. The cotton, mordanted by any one of the above methods, is introduced into a cold, freshly made decoction of logwood, and the temperature is gradually raised to the boiling-point. A small amount of extract of old fustic or of quercitron bark is usually added to the logwood solution. If an iron mordant only has been used, a small quantity of copper sulphate may with advantage be added to the bath to prevent rustiness. After dyeing, the cotton may be passed through a solution of bichromate of potash (5 grms. to the litre) at 60° C. (140° F.), greater intensity being thus obtained. The cotton is then (after dyeing) worked, at a moderate temperature, in a solution of soap containing 5 grms. of soap per litre; it is then squeezed and dried.

Applications to Wool. Logwood blacks on wool are divided into three classes: viz. chrome black, copperas black, and woaded black, according to the materials employed.

Chrome Blacks. 1. Mordant wool for 1 to 1½ hours at 100° C. (212° F.) with 3% of bichromate of potash and 1% of sulphuric acid of 168° Tw. (1·84 sp. gr.). Wash and then dye in 35% to 50% logwood for 1 to 1½ hours at 100° C. (212° F.). This gives a *blue-black.*

2. A *dead-black* is produced by adding 5% old fustic to the dye-bath.

3. A *green-black* is obtained if the proportion of old fustic is increased to 10%, with the addition of 3% to 4% of alum to the mordanting bath.

4. *Violet-black.* The dyeing is carried out as for blue-black, with the exception that, when the dye-bath is exhausted, 2% of stannous chloride (tin crystals) or its equivalent of commercial muriate of tin is added in dilute solution, and the boiling continued for 15 to 20 minutes. When black yarn, which is to be interwoven with white or delicately coloured yarns, is dyed, it is necessary to thoroughly fix the colour on the fibre by passing the yarn, after dyeing, through a warm 0·5% bath of potassium bichromate, otherwise the lighter-coloured fibres will become stained.

Chrome blacks resist the action of scouring well, but they are liable to take up a greenish hue on exposure to light. This change may be rendered less apparent by the addition of some red colouring matter to the dye-bath. A good plan is to boil the wool with 6% to 8% of camwood for an hour, and then add to the exhausted bath potassium bichromate, &c.; this is required for mordanting after removing the fabric.

Copperas Black. This black has almost gone out of use since the introduction of chrome blacks.

"1. Mordant the wool for 1½ to 2 hours with 4% to 6% of ferrous sulphate, 2% copper sulphate, 2% alum, and 8% to 12% argol; take out, squeeze, and leave at rest over night. Dye for 1½ hours with 40% to 50% of logwood.

"2. Boil the wool for 1 hour with a decoction of 40% to 50% of logwood, and 5% to 10% of old fustic; lift, cool the bath, add 4% to 6% of

ferrous sulphate, and 2% of copper sulphate; re-enter the wool, raise the temperature to 100° C. in three quarters of an hour, and boil for half an hour. The first method is the more economical" (from Hummel's 'Dyeing of Textile Fabrics').

Bonsor's Black. This consists of a ready-prepared black in the form of a paste, produced by precipitating a solution of logwood with a mixture of ferrous and copper sulphates. Add to the dye-bath 25% to 30% of the paste and 2% to 3% of oxalic acid; dye at 100° C. for 1 to 2 hours. The liquor should be dark brown in colour; if it is blue or green, more oxalic acid must be added to dissolve the whole of the dye. The bath must not be too acid, however, and it is advisable, after the boiling has been continued for some time, to take out the wool and partially neutralise the acid with sodium carbonate. If a deeper black is required, some logwood extract may be added to the dye-bath, but the dyeing is rendered more difficult by this proceeding.

Woaded Blacks. The wool is dyed first in the indigo vat (which *see*), washed and dyed as for chrome or ferrous sulphate blacks. If the former method is used, it is better to omit the sulphuric acid in mordanting, otherwise the chromic acid liberated is apt to oxidise the indigo.

Application to Silk. Lyons black (dating from 1860), for expensive articles.

"1. Mordant in a cold strong bath of basic ferric sulphate, of 50° Tw. (1·25 sp. gr.), once only, and wash.

"2. Soap at 85°—90° C.

"3. Dye blue with 15% to 20% of potassium ferrocyanide and an equal weight of hydrochloric acid of 30° Tw. (1·15 sp. gr.). Add the hydrochloric acid in two separate portions.

"4. Mordant with basic ferric sulphate and wash.

"5. Give a catechu bath, containing 50 to 100 parts of catechu to 100 parts of water, at 60°—80° C.

"6. Mordant in a cold solution of alum or aluminium sulphate, and wash. The object of using aluminium mordant is to impart ultimately to the silk a violet or blue-black shade.

"7. Dye with logwood and soap. If the shade is too violet, a little old fustic is added.

"8. Brighten.

"*Black on boiled-off Silk, weighted* 20% *to* 100% (*heavy black*). This black is dyed on organzine and tram for satins, sarcenets, taffetas, &c.

"1. Mordant with basic ferric sulphate, then soap. Repeat these operations 1 to 8 times, according to the amount of weighting necessary.

"2. Dye blue; the proportions of potassium ferrocyanide and hydrochloric acid vary according to the amount of ferric oxide fixed on the silk.

"3. Give a catechu bath, containing 100 to 150 parts of catechu to 100 parts of water, with the addition of 10% to 15% stannous chloride, at 60°—80° C.

"The employment of stannous chloride in weighted black-silk dyeing has been of the greatest importance, since it facilitates the fixing of the catechu to a surprising degree, through the formation of a tannate of tin.

"4. Give a second bath of catechu, containing 100 to 200 parts of catechu to 100 parts of water. This is fixed on the silk only by the action of the tin mordant present.

"5. Mordant with pyrolignite of iron.

"6. Dye with logwood and soap.

"7. Brighten.

"*Blue shades of black* are obtained by repeating operations 5, 4, 6, in the order given, 4 times. The only factors which affect the limitation of weighting are the strength, elasticity, and lustre of the silk itself. As a rule, boiled-off organzine is weighted 60% to 70%, and boiled-off tram 100%.

"*Heavy black, weighted to* 400%. This is used for fringes and the fancy articles of Paris and Lyons; also for the tram silk for satin, cheap ribbons, &c.

"The raw silk is dyed by working it alternately in chestnut extract and pyrolignite of iron. By repeating these operations 15 times, the silk is weighted to about 400%. The final processes consist of brightening operations with 10% to 20% of olive oil. In the first chestnut extract bath, tram is soupled by raising the temperature of the bath sufficiently to soften the silk glue. Different qualities of silk require slightly different treatment. Bengal silk souples easily; Chinese silk less readily than European silk" (Hummel's 'Dyeing of Textile Fabrics').

Aniline Black. Application to Cotton. This dye consists of an oxidation product of aniline, and is always produced on the fibre itself. Two tints are obtained, according to the amount of oxidation which takes place. The less oxidised product has a blue-black colour somewhat sensitive to acids; the more oxidised product has a violet-black colour which is not affected by acids. Two methods of dyeing are used.

Warm Method. The dye-bath consists of the following ingredients: 1600 litres of water, 40 kilos. of hydrochloric acid of 34° Tw. (1·17 sp. gr.), 10 kilos. of aniline, and 10 to 14 kilos. of bichromate of potash. This bath is sufficient for 100 kilos. of cotton.

The aniline and acid, the latter slightly diluted, are first mixed and then added to the larger portion of the water. The bichromate of potash dissolved in the rest of the water is now poured in. The cotton is worked for an hour in the cold solution, after which the temperature is slowly raised, the operation lasting for another 2 hours.

The intensity of the colour is proportional to the amount of aniline used. The dyeing takes place more rapidly the more concentrated the solutions and the greater the proportion of acid, but bronze-blacks are apt to be produced. The temperature must be raised very slowly. After dyeing, the cotton is washed, boiled in a solution of soap containing 5 to 10 grms. per litre, and dried.

Cold Method. For 100 kilos. of cotton take 16 to 20 kilos. of hydrochloric acid of the same strength as before, 20 kilos. of sulphuric acid of 168° Tw. (1·84 sp. gr.), 5 to 10 kilos. of aniline, 14 to 20 kilos. of bichromate of potash, and 10 kilos. of ferrous sulphate. The quantity of water is much smaller than before, mechanical arrangements being generally used so that the yarns are

only partially immersed in the concentrated liquid and are kept in rotation. The cotton is usually worked in a solution of about half the final strength for half an hour, and then transferred to the stronger bath.

Cotton dyed by either of the above methods should be submitted to a final oxidation if the fabric is to be perfectly ungreenable. The following method is serviceable in this case:—Prepare a mixture of 20 kilos. of ferrous sulphate, 5 kilos. of bichromate of potash, 15 to 20 litres of sulphuric acid of 168° Tw., and 60 to 70 litres of water. Add 5 litres of this mixture to 500 litres of water, and work the cotton for three quarters of an hour at 75° C. (167° F.), then wash, boil with soap, and dry.

Application to Wool and Silk. The application of aniline-black to these has, up to the present, not been very satisfactory.

BLACK JACK. This term is applied to burnt sugar, which is used to colour beverages, and more particularly for the adulteration of coffee. It is also known under the name of 'coffee refined,' and as such is vended in tin canisters. It is moreover employed to give colour to vinegar, brandy, and rum. Butter, with which water has been largely incorporated, is also known as 'Black Jack.' See CARAMEL.

BLACK-LEAD (-lĕd). See PLUMBAGO.

BLACK PIG'MENTS. *Syn.* PIGMEN'TA NI'GRA, L. The principal black pigments of commerce are obtained by carbonising organic substances (particularly bones), by exposure to a dull red heat, in covered vessels out of contact with the air; or by collecting the soot formed during the combustion of unctuous, resinous, and bituminous matters. Artists and amateurs also prepare, on the small scale, a variety of blacks, many of which are not procurable at the colour-shops. This they effect either by the carbonisation of substances not usually employed for the purpose, or by simply reducing to powder certain mineral productions selected on account of the peculiar shades of colour which they respectively possess. Some of the last might, however, be more appropriately classed with browns. The following list embraces most of these articles:

Black, An'imal. Bone-black.

Black, Aniline. See TAR COLOURS.

Black, Beech. Carbonised beech-wood.

Black, Blue-. Vine-twigs dried and then carefully carbonised, in covered vessels, until of the proper shade. That of the ancients was made of wine-lees. Pit-coal, carefully burnt at a white heat, then quenched in water, dried and well-ground, forms a cheap, good, and durable blue-black, fit for most ordinary purposes. See FRANKFORT BLACK.

Black, Bone. *Syn.* I'VORY-BLACK (of *commerce*); CAR'BO OS'SIS, OS US'TUM NI'GRUM, E'BUR U. N. (vena'le), &c., L.; NOIR D'OS, &c., Fr.; KNOCHENSCHWARTZ, &c., Ger. Carbonised bones reduced to powder. That of commerce is usually the residuum of the distillation of bone-spirit. Inferior to true ivory-black; having a slight, but peculiar reddish tinge, from which the latter is quite free. Besides its use as a pigment, it is extensively employed in making blacking, as a material for the moulds of founders, as a clarifier and bleacher of liquids, &c. See IVORY-BLACK and CHARCOAL, ANIMAL.

Black, Cas'sel, Cologne Black. Ivory-black.

Black, Coal. See BLUE-BLACK and NEWCASTLE BLACK.

Black, Composi"tion (-zĭsh'-ŭn). The selected portion of the residuum of the process of making prussiate of potash from blood and hoofs. Used both as a pigment and to decolour organic solutions, which it does better than bone-black.

Black, Cork. Spanish black.

Black, Flo"rey, FLORÉE D'INDE. The dried scum of the dyer's wood-bath. A superior blue-black.

Black, Frankfort, NOIR DE FRANCFORT. From vine-twigs dried, carbonised to a full black, and then ground very fine. An excellent black pigment; also used by the copper-plate printers to make their ink. See BLUE-BLACK.

Black, Gas. The hard, somewhat coke-like soot which deposits over a gas-burner. This is a most excellent black for many purposes, as it can be ground to an impalpable powder and mixed with any suitable medium such as gum, varnish, &c.; useful as a dead black for photographic purposes.

Black, Harts'horn. Resembles ivory-black, which is now usually sold for it. It was formerly prepared by carbonising the residuum of the distillation of spirit of hartshorn.

Black, I'vory-. *Syn.* CAR'BOE B'ORIS, E'BUR US'TUM NI'GRUM, L.; NOIRE D'IVOIRE, &c., Fr.; ELFENBEINSCHWARTZ, KOHLE VON ELFENBEIN, Ger. From waste fragments and turnings of ivory, by careful exposure in covered crucibles, avoiding excess of heat or over-burning. The whole having been allowed to become quite cold, the crucibles are opened and their contents reduced to fine powder. For the first quality only the richest-coloured portion of the charcoal is selected, and this, after being powdered, is ground with water on porphyry, washed on a filter with warm water, and then dried. A very rich and beautiful black. It is brighter than even peach-stone black, and is quite free from the reddish tinge of bone-black. With white-lead it forms a rich pearl-grey. See BONE-BLACK.

Black, Jamai'ca (-mā'-). Sugar-black.

Black, Lamp'-. *Syn.* FULI'GO LUCER'NÆ, F. PI'NEA, &c., L.; NOIR DE FUMÉE, &c., Fr.; KIENRUSS, &c., Ger. *Prep.* 1. (On the small scale.) A conical funnel of tin-plate furnished with a small pipe to convey the fumes from the apartment, is suspended over a lamp fed with oil, tallow, coal-tar, or crude naphtha, the wick being large and so arranged as to burn with a full smoky flame. Large spongy, mushroom-like concretions of an exceedingly light, very black, carbonaceous matter, gradually form at the summit of the cone, and must be collected from time to time. The funnel should be united to the smoke-pipe by means of wire, and no solder should be used for the joints of either.

2. (*Commercial.*) On the large scale, lamp-black is now generally made by burning bone oil (previously freed from its ammonia), or common coal-tar, and receiving the smoke in a suitable chamber. In the patented process of Messrs Martin and Grafton the coal-tar is violently

agitated with lime-water until the two are well mixed, after which it is allowed to subside, and the lime-water having been drawn off, the tar is washed several times with hot water. After subsidence and decantation it is put into stills, and rectified. The crude naptha in the receiver is then put into a long cast-iron tube furnished with numerous large burners, underneath which is a furnace to heat the pipe to nearly the boiling-point. Over each burner is a sort of funnel which goes into a cast-iron pipe or main, which thus receives the smoke from all the burners. From this main the smoke is conveyed by large pipes to a succession of large boxes or chambers, and thence into a series of large canvas bags arranged side by side, and connected together at top and bottom alternately. Fifty to eighty of these 'bags' are employed; the last one being left open to admit of the escape of the smoke, which has thus been made to traverse a space of about 400 yards. As soon as the bags contain any considerable quantity of black they are removed and emptied. The black deposited in the last bag is the finest and best, and it becomes progressively coarse as it approaches the furnace.

Obs. The state of minute division in which the carbon exists in good lamp-black is such as cannot be given to any other matter, not even by grinding it on porphyry, or by 'elutriation' or 'washing over' with water. On this account it goes a great way in every kind of painting. It may be rendered drier and less oily by gentle calcination in close vessels, when it is called burnt lamp-black, and may then be used as a water-colour; or its greasiness may be removed by the alkali-treatment noticed under Indian ink. It is the basis of Indian ink, printer's ink, and most black paints.

Russian lamp-black is the soot produced by burning the chips of resinous deal. It is objectionable chiefly from being liable to take fire spontaneously when left for some time moistened with oil.

Black, Manganese′ (-nēze′). Native binoxide of manganese. Durable and dries well.

Black, Newcas′tle. From the richer-looking varieties of pit-coal by grinding and elutriation. Brown-black or, in thin layers, deep brown. It is, perhaps, "the most useful brown the artist can place on his palette; being remarkably clear, not so warm as Vandyke-brown, and serving as a shadow for blues, reds, and yellows, when glazed over them. It seems almost certain that Titian made large use of this material." See BLUE-BLACK (*antè*).

Black, Opor′to. Carbonised wine-lees.

Black, Par′is, NOIR DE PARIS. From turner's bone-dust, treated as for ivory-black. Works well both in oil and water. It is commonly sold for real ivory-black, and for burnt lamp-black.

Black, Peach-stone. From the stones or kernels of peaches, cherries, and other similar fruits, treated as for ivory-black. A bright, rich black; works well with oil; with white-lead and oil it makes old grey.

Black, Pit-′coal. Newcastle black.

Black, Prussian (prŭsh′-ăn). Composition-black.

Black, Rice. Rice-charcoal. Inferior.

Black, Rus″sĭan. See LAMP-BLACK.

Black, Soot (sōōt). The soot of coal-fires, ground and sifted. Used in common paint, and to colour whitewash; with Venetian-red and oil it makes chocolate-colour; also used to make grey mortar.

Black, Span′ish. From cork-cuttings carbonised, as bone-black. Resembles Frankfort black, but works softer.

Black, Sugar (shōōg′-). Carbonised moist sugar. Has little body, but for washing drawings is equal in mellowness to Indian ink and bistre.

Black, Sun′derland. Newcastle black.

Black, Tur′ner's. Paris black.

Black, Vine′-twig. Frankfort black.

Black, Wheat′- (hwēte′-). Carbonised wheat. It has a good colour, a full body, and dries hard and quickly with oil.

BLACK′BERRY. The popular name of *Ru′bus frutico′sus*, Linn., or the common 'bramble.' Fruit (BLACK′BERRIES; MURES DE RONCE, Fr.), antiscorbutic and wholesome, but in excess apt to sicken; twigs used in dyeing black; root astringent, formerly used in hooping-cough.

Blackberry, Amer′ican. The *Ru′bus villo′sus*, Ait. Root astringent and tonic; officinal in the Ph. U. S.

Blackberry Cultivation. The following is from an article which appeared in the 'Standard' newspaper in 1889: The growing and gathering of blackberries is the latest addition to the list of rural industries; and, as the fruit can be readily sold at from 2*d.* to 2½*d.* the pound, large hampers are, during the season, daily sent to London from the Kentish farms. And it is believed that, as an organised business, the picking of this wild fruit might for several weeks in the autumn, after both strawberries and raspberries have disappeared from the market, add substantially to the profits of the British agriculturist. Blackberries may be made to pay nearly as well as strawberries, out of which in some summers better profits were made than from any other crop, and, unlike that fruit, it requires absolutely no attention until the time for plucking it arrives, while the season lasts for at least two months. The berry is a wild one. It prospers in almost any soil, and it is seldom affected by frosts or disease. Neglected hedgerows in the heavy clay districts are much favoured by it, and, apart from the fact that it forms an almost impenetrable fence of the most picturesque description, it is just in such districts that land is of least value. It is, therefore, worth considering that a few acres of ground, at present all but worthless, and certainly not utilised by any crop for which 2*d.* a pound can be obtained, might be devoted to the more systematic growth of this species of *Rubus*. No native berry grows more rapidly, or bears more plentifully; and though much labour spent on it is not for the present advisable, anyone who has seen the large juicy berries which cluster on the trailing stems rooted in favourable spots and exposed to the autumn sun must be convinced that a little care in selecting the place for the blackberry thicket, or an old fence for it to lean on, would be amply repaid by the result. Besides our common wild species, there are also many American forms, little known in this country, such as the salmonberry and the peculiarly

piquant thimbleberry which grows on the Pacific Slope as far north as Alaska, both of which ought to do well in this country, though they do not grow in the haphazard, trailing fashion of our bramble, but, like the raspberry, erect in thickets. It is easy for the surplus to be utilised, without gorging the market with unsaleable berries. The fruit can be dried in the sun or on hair sieves, as many other berries are, and still preserve their flavour sufficiently well to form a palatable dish, on being boiled, during winter. Or they can be made into jam or jelly, and in country places a 'wine' is often squeezed from them, which in the esteem of rural connoisseurs excels all similar vintages. The fruit can also be preserved whole without sugar by a very simple and inexpensive fashion of bottling, and in this way be kept good for months at a time. It is, therefore, manifest that more unpromising schemes than those for the systematic cultivation of the bramble have been mooted. Up to the present date our wild fruits have been sadly neglected. The picking of the berries has been left to children, or to women who had nothing better to do, and it has never occurred to anyone that ground unfitted for more profitable culture might be usefully employed in raising crops of this description under more favourable conditions than usually occur in a savage state. In America the farmers are wiser. They not only pay some attention to improving the wild species, but they collect in a most industrious manner, just as they would any other crop, the fruits of the hills, woods, and swamps. Thousands of barrels are prepared for winter use, or despatched to the cities for sale. From June to the end of September 'berrying parties' are got up in the more remote districts. Camps are formed, and families will often remain from home for a week or ten days on these not unprofitable, extremely pleasant, and most picturesque expeditions. The Scandinavian peasants also find employment in collecting the berries of their forests and mountains, and as far north as Greenland the season of wild fruits is an important one for the Eskimo. Crowberries, whortleberries, and cowberries ripen well in the Arctic regions during the brief summer, and even develop a flavour superior to their kindred further south. Sometimes during the winter they are scraped up from under the snow, and the crowberries, which grow so thickly that, except in the swamps and half-inundated places, it is almost impossible to cut a sod without finding it matted with this plant, are still quite fresh when they come to light by the melting of the snow in June. Sackfuls are gathered, and consumed in August and September, or the juice is expressed, and made into a passable sort of cider; while in winter the invariable animal diet of a region where no cultivated vegetable thrives is relieved by a dish of berries served up with slices of blubber, and eaten as a dessert in the native huts.

In this country we have not the wonderful variety of small wild fruits found in North America, but we have, nevertheless, plenty that could be utilised. The thimbleberry and the salmonberry, the huckleberry and the partridgeberry, the serviceberry, so extensively dried in Western Canada, and the more mawkish, but still pleasant, salal of the Far West are not much known here, though they are grown in our gardens. But, considering the climate of the regions in which they flourish, there cannot be a doubt but that all of them would soon become perfectly naturalised in any part of Great Britain. Even as it is, with the whortleberry and the cowberry, the bramble, the cranberry, and the gean, or wild cherry, and the more acrid sloe or blackthorn, we are not to be pitied. The 'gean' is common in many old-fashioned hedgerows, and produces a sweet pleasant fruit; and the sloe, rough though its plums are, has long been made into a preserve, and, it is said, forms the basis of a 'port wine'—so very vile that even this surly vegetable deserves a better fate. It is certain that our swampy places—and in spite of Drainage Acts and High Farming these still abound in the land—might be cropped very profitably with cranberries. The native species is a fair fruit, but small, and not equal, from an economical point of view, to the two American varieties, which are larger, and superior to it in flavour. In the United States both are not only collected in their wild state, but are cultivated to such purpose that in the vicinity of Cape Cod, in Massachusetts, every acre of wide tracts of waste land, originally worth not more than from £2 to £4, yields a crop readily saleable at from £20 to £40. After the plants have begun to bear well, about 100 bushels, or 35 barrels, are estimated to be an average crop, and so extensively has the business been pursued, that twenty years ago 75,000 barrels were annually sold in the Eastern States, or exported to the West Indies, England, France, and other countries. At the present time the yield must be more than doubled. Our home demand used to be supplied by Lincolnshire and Norfolk; but of late, either because land is getting drained, or owing to the cheaper supplies from abroad, or because we prefer the better ones from foreign parts, the home crop has fallen off, and the growing demand is met by large imports from the United States, Russia, and Sweden. Not many years ago cranberries were sold in Norwich by the cartload, and at Longton, on the borders of Cumberland, it was nothing uncommon for £30 or £40 worth to be disposed of in one day—all these berries being gathered in an otherwise barren district.

BLACK'ING. *Syn.* Cirage (des bottes), Noir (pour les souliers), Fr.; Schwärze, Schuhschwärze, Ger. An article too well known to require description.

Hist., &c. Blacking and other polishes for leather were undoubtedly in common use among the ancients; but the compound to which we now more particularly apply the name is of comparatively modern invention. The latter appears to have been first introduced into England from Paris during the reign of Charles II, but was not in common use among the masses of our population much before the middle of the 18th century.

The general and still increasing use of blacking as a polish for boots and shoes by all classes of the inhabitants of civilised countries has given an extent and importance to its manufacture which a stranger to the subject would scarcely be led to expect. The princely establishments of

some of the firms who compound this sable article cannot fail to have arrested the attention of the passenger through the streets of this great metropolis; whilst the enormous fortune acquired by one of their late members, and, for the most part, bequeathed by him for purposes of charity and philanthropy, has invested both the donor and his craft with an interest and notoriety which they did not previously possess. At the present time the consumption of blacking is greater than at any former period; and of this, as of many other articles, England is the principal manufactory for the world, alike distinguished for the extent of her trade and the excellent quality of this product of her industry. In truth, England excels all other nations in the manufacture of common shoe-blacking; and perhaps in no other country is an equal attention paid to the cleanliness and appearance of the external clothing of the feet.

Prep. I. LIQUID BLACKING:

1. Take of bone-black, 16 parts; treacle, 12 parts; oil of vitriol, 3 parts; sperm oil (sperm oil is commonly regarded as the best for blacking; but pale seal oil is thought by some to be quite as good. The cod-liver oil of the curriers, if clear, is less expensive, and probably better than either of them. Common olive oil and refined rape oil are, however, those most generally used by the blacking-makers), 2 parts; gum arabic, 1 part; strong vinegar, or sour beer, 48 to 50 parts—that is, 3 to 3½ times the weight of the ivory-black (all by weight); place the bone-black in a capacious wooden, stoneware, or enamelled-iron vessel (metallic vessels must be avoided), add the oil, and rub them well together; next gradually add the treacle, and actively and patiently grind or rub the mass after each addition until the oil is perfectly killed, and finally for some time afterwards, to ensure complete admixture; then cautiously dilute the vitriol with about three times its bulk of water, and add it, in separate portions, to the former mixture, observing to stir the whole together as rapidly as possible on each addition of the acid, and for some minutes after the whole is added, so as to render the mass thoroughly smooth and homogeneous; let it stand, covered over, for two or three days or longer, stirring it, in the meantime, for 15 or 20 minutes daily; lastly, having dissolved the gum in the vinegar, add the solution gradually to the rest, and stir the whole together briskly for some time, and again daily for 3 or 4 days. It may be further diluted, at will, with a little more vinegar or beer, or with water; but unnecessary or excessive dilution should be avoided, as the richness and quality of the blacking become proportionately reduced. If all the ingredients (except the vitriol) be made hot before admixture, the shining quality of the product will be greatly improved, and the process may be shortened. By taking the 'parts' ordered in this and the other formulæ as so many ¼ *lbs.*, *lbs.*, ¼ *cwts.*, or *cwts.*, the proportions of each ingredient for any quantity of blacking, from a ¼ of a *lb.*, or a ¼ pint, up to 2 *tons*, or nearly 450 galls., will be at once seen; and so on of even larger quantities. See Concluding Remarks (*infrà*).

2. Ivory-black, 16 parts; treacle, 8 parts; oil of vitriol, 4 parts; (diluted with) water, 2 parts; oil, 2 parts; gum arabic, 1 part; soft water (for the final dilution instead of vinegar), 64 parts; mixed, &c., as before. Excellent.

3. As the last: but taking only 6 parts of treacle, 1 part of oil, and omitting the gum arabic. Good. A commoner kind of liquid blacking does not sell.

4. (Bryant and James's INDIA-RUBBER LIQUID BLACKING. Patent dated 1836.) Take of india-rubber (in small pieces), 18 *oz.;* hot rape oil, 9 *lbs.* (say 1 gall.; dissolve; to the solution add of ivory-black (in very fine powder), 60 *lbs.;* treacle, 45 *lbs.;* mix thoroughly; further add of gum arabic, 1 *lb.*, dissolved in vinegar (No. 24), 20 galls.; reduce the whole to a perfect state of smoothness and admixture by trituration in a paint-mill; throw the compound into a wooden vessel, and add, very gradually, of sulphuric acid, 12 *lbs.;* continue the stirring for half an hour, repeating it daily for 14 days; then add of gum arabic (in fine powder), 3 *lbs.* (this should be gently rubbed through a sieve, held over the blacking by one person, whilst another stirs the mass assiduously with the spatula); again mix well, and repeat the stirring for half an hour daily for 14 days longer, when the liquid blacking will be ready for use or for bottling. The quality is very excellent; but this, probably, does not depend on the presence of the india-rubber, but on the general correctness of the proportions and the care and completeness with which they are mixed.

5. (*Without Vitriol.*) Take of ivory-black (in very fine powder), 2 *lbs.;* treacle, 1½ *lbs.;* sperm oil, ¼ pint; mix as before; then add of gum arabic, 1 *oz.;* (dissolved in) strong vinegar, ½ pint; mix well; the next day further add of good vinegar or strong sour beer, 3 to 4 pints (or q. s.); stir briskly for a quarter of an hour, and again once a day for a week. Excellent. A cheaper, but inferior article, may be made by the reductions and omissions noticed above.

6. From paste blacking (see *below*), by reducing it with sufficient vinegar, sour beer, or water to give it the liquid form. It is sometimes convenient to prepare liquid blacking in this way from a stock of 'paste blacking' already on hand.

II. PASTE BLACKING:

1. Qualities from good to superexcellent may be made from any of the preceding formulæ by simply omitting the final dilution with the vinegar, sour beer, or water, therein ordered at the end of the process.

2. (Bryant and James's INDIA-RUBBER PASTE BLACKING. Patent dated 1836.) Of india-rubber, oil, ivory-black, treacle, and gum arabic, the same as for their liquid blacking (see 1, 4, *above*), but dissolving the last in only 12 *lbs.* (say 5 quarts) instead of 20 galls. of vinegar; grinding to a smooth paste in a colour-mill, and then adding of oil of vitriol, 12 *lbs.* as before. The mass is to be stirred daily for a week, when it will be fit for use, or potting. The final addition of the 3 *lbs.* of powdered gum, ordered in the formula of their liquid blacking, is not mentioned by the patentees; and we therefore presume they do not intend it to be made. If

made, it should be at the end of the week, and the daily stirring must then be continued for another week. This addition, or omission, enables us to produce two qualities from the same formula. Excellent.

3. Ivory-black, 1 *cwt.;* treacle, 28 *lbs.;* rape oil (or other cheap oil), 1 gall.; mix as before; then add of oil of vitriol, 21 *lbs.;* (diluted with) water, 2 galls.; mix them quickly and thoroughly by forcible stirring with a strong wooden spatula, and as soon as admixture is complete, but whilst still fuming, put the cover on the tub, and leave it till the next day, when (without further stirring) it will be fit for use or sale (the object here is to make the product as spongy and light as possible, so that the purchaser may fancy he has a great deal for his money). Good ordinary. Used for packets and tins.

4. As the last; but adding with the ivory-black, &c., 14 to 28 *lbs.* of coal-soot (this is also to give bulk) (sifted), omitting one half of the oil, and diluting the vitriol with an extra gall. of water. Inferior. Chiefly used for 1*d.* and ½*d.* packets. A still more common article is vended in the north of England and in Scotland, in which the oil is omitted altogether. The sale of such blackings (?) is disreputable, when it is remembered that a really good article may be made for 2*d.* to 2½*d.* per *lb.*

5. (German Blacking.) Ivory-black, 1 part; treacle, ½ part; sweet oil, ⅛ part; mix, as before; then stir in a mixture of hydrochloric acid, ⅛ part; oil of vitriol, ¼ part (each separately diluted with twice its weight of water before mixing them). This forms the ordinary paste-blacking of Germany, according to Liebig.

6. (*Without Vitriol.*) As I, 5 (*antè*); but with the omission of the last ½ gall. of 'vinegar.'

Concluding Remarks. To produce a first-rate sample of blacking it is absolutely necessary that the ingredients be of the best quality, and used in the proper proportions; and that the order of their admixture, and the general manipulations, be conducted, under ordinary circumstances, in the manner described in the first of the above formulæ. The proportions of the treacle and the oil (the most expensive of the ingredients) should not be stinted; and, indeed, that of the latter may be safely increased in quantity, without materially affecting the polish, and with manifest advantage as far as the softness and durability of the leather to which it is applied is concerned. The manipulations required in the manufacture of both paste blacking and liquid blacking are essentially the same; the difference between the two articles, when the same materials are used, depending entirely on the quantity of liquid added. Thus, as noticed before, by diluting paste blacking with water, vinegar, or beer-bottoms, it may be converted into liquid blacking of a nearly similar quality; and, by using less fluid matter, the ingredients of liquid blacking will produce paste blacking. One thing must, however, be observed, and that is, that the ivory-black used for liquid blacking should be reduced to a much finer powder than for paste blacking; as, if this is not attended to it is apt to settle at the bottom, and to be with difficulty again diffused through the liquid. Persons who object to the use of blacking containing oil of vitriol may employ formula I, 5, or II, 6, *above*). The vitriol, however, greatly contributes to promote the shining properties of the blacking; and, in small quantities, or in the proper proportion, is not so injurious to the leather as some persons have represented; as it wholly unites itself to the lime of the bone-phosphate contained in the ivory-black, and is thus neutralised, insoluble sulphate of lime, and an acid phosphate or superphosphate, being formed. It is the latter that gives the acidity to a well-made sample of blacking, and not the sulphuric acid originally added to it. In this way the larger portion of the ivory-black is reduced to a state of extremely minute division, and with the other ingredients forms a strongly adhesive paste, which clings to the surface of the leather, and is susceptible of receiving a high polish by friction when in a scarcely dry state. This is the reason why lamp-black should never be employed for blacking to the exclusion of the necessary proportion of bone-black, as it has no earthy base to absorb or neutralise the acid, which, if left in a free state, would prove very hurtful to the leather. Oil of vitriol is now employed in the manufacture of all the more celebrated and expensive blackings; and that simply because no other substance is known so efficient, and so little injurious to the leather. In the common blackings of Germany hydrochloric acid is often used to the entire exclusion of oil of vitriol; but blacking so prepared possesses several disadvantages from which that of England is free. In the best German blackings only a small portion of this acid is used, as may be seen by reference to formula II, 5 (*above*). The addition of white-of-egg, isinglass, and similar articles (in Scotland, flour-paste soured by keeping is often substituted for part of the treacle in the common blackings; with the effect, however, of greatly impairing their polishing qualities, and causing the leather to rapidly become stiff and to crack; further, such blacking will not keep, often growing mouldy and hard in two or three weeks) to blacking always proves injurious, as they tend to stiffen the leather and to make it crack, without at all improving its polishing properties. Even gum arabic, in quantity, is on this account objectionable. Oil has an opposite tendency, and, as already stated, the quantity commonly used may be increased with advantage. Resin oil should be particularly avoided.

Dr Ure has recommended the use of a little copperas (in proportion of ¼ *oz.* to each *lb.* of bone-black, dissolved in 10 parts of water, and to be added with the vitriol) in blacking; with the object, we presume, of striking a black with the tan in the leather; but except with new, or nearly new leather, this effect would not occur, whilst its presence, if not objectionable, would otherwise be useless.

The only improvement that has been introduced in the manufacture of blacking since the early days of the celebrated Day and Martin is, a few hours after the conclusion of the mixture of the ingredients (but before adding the vinegar,

if any), to simmer the whole very gently for about 8 or 10 minutes, observing to stir it assiduously all the time. The fire must then be withdrawn, and the pan covered over until it is quite cold, when half an hour's lusty stirring will finish the process. A capacious enamelled cast-iron boiler, with a concave bottom, should be used for this purpose; in which case the ingredients can be mixed in it, and thus the trouble of removal avoided. If a common copper or cast-iron boiler be employed, the blacking must not be allowed to remain in it longer than necessary to give it the 'simmer,' at the conclusion of which it should be turned out into a wooden tub or vat to cool. In this way a degree of maturity and brilliancy will be imparted to the product, which, without the application of heat, it would take months to acquire, if, indeed, it ever reached it.

As it is generally more convenient to measure than to weigh liquids, it may be useful to remind the reader that, in round numbers,

1 gal. of oil		weighs	$9\frac{1}{4}$ *lbs.*
1 „	sour beer	„	$10\frac{1}{4}$ „
1 „	vinegar	„	10 „
1 „	water	„	10 „

We may here further remark that the blackings of different houses vary considerably in some of their properties; as also do those of even the same maker by age. Some blackings dry off rapidly and give a very brilliant polish with very little labour; whilst others take a little longer to 'dry off,' and somewhat more labour to polish them. The former are best adapted to hasty use, and when a very brilliant surface is desired; the latter when depth of polish, without extreme brilliancy, satisfies the wearer. The first best meets the requirements of fashionable life; the last those of the middle classes and pedestrians exposed to dirt, mud, and the various vicissitudes of travelling and weather. To the one belong the 'blackings' of Everett, Day and Martin, &c.; to the other, those of Warren, Bryant and James, and most of the smaller manufacturers, with nearly all the paste blacking of the more respectable shops. Time, however, equalises the qualities of these two classes. Blackings which are crude, moist, and oily lose these properties, and become drier and more brilliant by age. The practice of several of the first-class West-end boot and shoe makers is never to use a blacking which they have not had in their stock at least a twelvemonth.

Blacking, both liquid and paste, should be stored in a cool and moderately dry cellar; and when in use should be kept corked or otherwise excluded from the air. Exposure or desiccation destroys most of its best qualities.

The present annual value of the blacking consumed in the United Kingdom is estimated at £562,500, or about $4\frac{1}{2}$*d.* per head for the whole population; while the collective yearly value of that exported is about £35,000.

[See Balls, Blacking, Bone-black, Boots and Shoes, Leather, Sulphuric Acid, &c.; also *below*.]

Blacking, Acme. Rectified spirit, 1 gall.; mother liquid, $\frac{1}{4}$ gall.; mix and add camphor, 11 oz.; Venice turpentine, 16 oz.; shellac, 36 oz. Dissolve in $\frac{1}{4}$ gall. benzine, $3\frac{1}{5}$ fl. oz. of castor oil, and $1\frac{3}{5}$ fl. oz. of boiled linseed oil. Unite the two solutions by agitation. Iron and zinc decompose the mixture.

Blacking, Automat′ic. *Syn.* Self-shi″ning blacking, Span′ish japan, &c. *Prep.* 1. Gum-arabic, 4 *oz.;* treacle or coarse moist sugar, $1\frac{1}{2}$ *oz.;* good black ink, $\frac{1}{4}$ pint; strong vinegar, 2 *oz.;* rectified spirit of wine and sweet oil, of each, 1 *oz.;* dissolve the gum in the ink, add the oil, and rub them in a mortar or shake them together for some time, until they are thoroughly united; then add the vinegar, and lastly the spirit.

2. Lamp-black, $\frac{3}{8}$ *oz.;* indigo (in fine powder), 1 *dr.;* put them in a mortar or basin, and rub them with sufficient mucilage (made by dissolving 4 *oz.* of gum in $\frac{1}{4}$ pint of strong vinegar) to form a thin paste; add very gradually of sweet oil, 1 *oz.;* and triturate until their union is complete, adding towards the end the rest of the mucilage; then further add of treacle, $1\frac{1}{2}$ *oz.;* and afterwards, successively, of strong vinegar, 2 *oz.;* rectified spirit, 1 *oz.;* lastly, bottle for use.

3. Mix the whites of 2 eggs with a tablespoonful of spirit of wine, 2 large lumps of sugar (crushed), and sufficient finely powdered ivory black to give the required colour and thickness, avoiding excess.

Obs. The above are chiefly used for dress boots and shoes. The first two are applied to the leather with the tip of the finger, or a sponge, and then allowed to dry out of the dust. The third is commonly laid on with a sponge or soft brush, and when almost dry or hard may have its polish heightened with a brush or soft rubber, after which it is left for a few hours to harden. It may also be used to revive the faded black leather seats and backs of old chairs. They all possess great brilliancy for a time; but are only adapted to clean, dry weather, or indoor use. They should all be applied to the leather as thinly as possible, as otherwise they soon crack off.

Blacking, Har′ness. Good glue or gelatine, 4 *oz.;* gum arabic, 3 *oz.;* water, $\frac{3}{4}$ pint; dissolve by heat; add of treacle, 6 *oz.;* ivory-black (in very fine powder), 5 *oz.;* and gently evaporate, with constant trituration, until of a proper consistence when cold; when nearly cold put it into bottles, and cork them down. For use, the bottle may be warmed a little to thin it, if necessary. Does not resist the wet.

2. Mutton suet, 2 *oz.;* beeswax (pure), 6 *oz.;* melt, add of sugar candy (in fine powder), 6 *oz.;* soft soap, 2 *oz.;* lamp-black, $2\frac{1}{2}$ *oz.;* indigo (in fine powder), $\frac{1}{2}$ *oz.;* when thoroughly incorporated, further add of oil of turpentine, $\frac{1}{4}$ pint; and pour it into pots or tins.

3. Beeswax, 1 *lb.;* soft soap, 6 *oz.;* ivory-black, $\frac{1}{4}$ *lb.;* Prussian blue, 1 *oz.;* (ground in) linseed oil, 2 *oz.;* oil of turpentine, $\frac{1}{2}$ pint; to be mixed, &c., as before.

Obs. The above are used by laying a very little of them on the leather, evenly spreading it over the surface, and then polishing it by gentle friction with a brush, or a soft rubber. The last two are waterproof. Numerous compositions of the class are vended by the saddlers and oilmen, but the mass of them are unchemical mixtures, badly prepared, and cause disappointment to those who use them. Such is not the case with the products of the above formulæ, if we may rely on the

statements of those who have employed them for years. The last two are suitable for both harness and carriage leather. See BALLS, HEEL, &c.

Blacking, Nu'bian. A lawsuit revealed the fact that Nubian blacking was originally known as Acme blacking. The patent was granted in 1877 to Booth as a communication from Wolff. It is No. 1750. The special claim is for the colouring matter, which is made as follows: Rectified spirit, 1 gall.; blue aniline, 31 dr.; yellow aniline or naphthaline yellow, 45 dr.; red aniline or fuchsine, 8 dr. The proportions may be varied slightly without affecting the result. If the colour is perfect it will after being decreased by four times its volume of alcohol appear of a greenish black cast when seen through a clear glass vessel; if held towards the sun a reddish hue is perceptible, but no determined shade can be fixed, the colour playing between green, black, and red.

The following is a more permanent colour: Rectified spirit, 1 gall.; blue aniline, 20·80 dr.; Bismarck brown aniline, 31·20 dr.

BLACK PUDD'ING. A pudding made of the blood of the pig, mixed with groats and fat. It contains about 11% of nitrogenous matter.

BLACK WOOD (*Dalbergia latifolia*, Roxb.). A large deciduous tree of Oudh, Eastern Bengal, Central and Southern India. The wood is extremely hard and of a dark colour, and is very valuable for furniture, carving, fancy work, as well as for cart-wheels, gun-carriages, &c.

BLADD'ER. *Syn.* VES'ICA, L.; VESSIE, Fr.; BLASE, BLATTER, Ger. In *anatomy*, &c., a thin membranous sac or bag, in an animal, serving as a receptacle for some secreted fluid; appr., the urinary bladder. See CALCULUS, INFLAMMATION, RUPTURE, &c.

Bladd'ers. (In *commerce*.) The better qualities of these articles are prepared by cutting off the fat and loose membranes attached to them, and washing them first in a weak solution of chloride of lime, and afterwards in clear water; they are then blown out and submitted to strong pressure by rolling them under the arm, by which they become considerably larger; they are next blown quite tight, dried, and tied up in dozens. Commoner qualities are merely emptied, the loose fat removed, and then blown out, and strung up to dry. Used chiefly by druggists and oilmen to tie over pots, bottles, and jars, and to contain pill-masses, hard extracts, and other similar substances; also in surgery, to cover wounds, sore heads, &c.—*Obs.* Bladders should never be purchased unless perfectly dry and air-tight; as, if the reverse be the case, they will neither keep nor prove useful, but will rapidly become rotten and evolve a most offensive odour. If purchased whilst damp, they should be at once hung up in a current of air, so as to dry as soon as possible.

BLAIN* (blāne). A boil; a sore; a pustule.

BLANC (blōng). [Fr.] In *cookery*, a dish which, according to Mrs Rundell, is formed of grated bacon and suet, of each, 1 *lb.*; butter, ½ *lb.*; 2 lemons; 3 or 4 carrots (cut into dice); 3 or 4 onions; and a little water; the whole being simmered for a short time, with or without the addition of a glass of sherry or marsala, before serving.

BLANCH'ING. *Syn.* ETIOLATION, CANDICA'TIO, DEALBA'TIO, &c., L.; BLANCHIMENT, &c., Fr.; BLEICHEN, &c., Ger. A whitening, or making white; a growing white. In some cases it means decortication. See ALMONDS, BLEACHING, DECOLORATION, &c.

Blanch'ing. In *cookery*, an operation intended to impart whiteness, plumpness, and softness to joints of meats, poultry, tongues, palates, &c. It is usually performed by putting the articles into cold water, which is then gradually raised to the boiling point, when they are at once taken out, plunged into cold water, and left there until quite cold. They are subsequently removed and wiped dry, ready for being dressed.

Obs. The operation of blanching meat, although it renders it more sightly according to the notions of fashionable life, at the same time lessens its nutritive qualities by abstracting a portion of the soluble saline matter which it contains, especially the phosphates, and thus deprives it of one of the principal features which distinguish fresh meat from salted meat. Animal food, before being dressed, may be washed or rinsed in cold water without injury provided it be quickly done; but it cannot be soaked in water at any temperature much below the boiling-point without the surface, and the parts near it, being rendered less nutritious. Washing meat when first received from the butcher is, indeed, a necessary act of cleanliness; but soaking it for some time in water is unnecessary, and for the reasons stated should be avoided.

Strong acetic acid (concentrated vinegar) poured on or rubbed over hard lean meat gradually renders it soft and gelatinous. Ordinary household vinegar has the same effect, but in a less degree. Tough meat thus treated for a short time before dressing it becomes more tender and digestible, though somewhat less nutritious; whilst the taste and flavour of the vinegar is removed by the heat subsequently employed in dressing it.

BLANCMANGE (blo-mōngzh'‡). *Syn.* BLANCMANGER (blong-mong-zhā), Fr. *Literally*, white food; in *cookery*, a confected white jelly. It is commonly prepared by simmering 1 *oz.* of isinglass, 2 or 3 *oz.* of lump sugar, and a little flavouring, in about a pint of milk, until the first is dissolved, when the whole is thrown into a jelly-bag, and the strained liquor is allowed to cool and solidify; it is next remelted by a gentle heat, and, when nearly cold, poured into moulds, which have been previously rubbed with a little salad oil and then wiped out again.

Obs. Good gelatine, or strong calves' feet jelly, is often substituted for the isinglass. At other times the jelly is made with about ½ pint of water (instead of milk), when ½ pint of almond milk, or of cream is added to the remelted jelly. Sometimes ground rice or arrowroot is employed in lieu of isinglass, when the product is called RICE-BLANCMANGE, or WEST-INDIAN B., as the case may be. TRANSPA''RENT BLANCMANGE is merely clarified isinglass-jelly, flavoured. See CREAM (*Stone*), ISINGLASS, and JELLY.

BLANQUETTE' (blang-ket'). [Fr.] In *cookery* a species of white fricasee. It is also the name of a delicate species of white wine, and of a particular sort of pear.

BLAST'ING. In *civil* and *military engineering*, the disruption of rocks, &c., by the explosion of gunpowder, or other like material.

BLAST'ING POWDERS (*Melville* and *Callow's*) *Prep.* 1. (POWDER No. 1.) Chlorate of potassium 2 parts; red sulphuret of arsenic, 1 part; to be separately carefully reduced to powder, and lightly mixed together, scrupulously avoiding the use of iron instruments, percussion, much friction, the slightest contact with acids, or exposure to heat.

2. (POWDER No. 2.) Chlorate of potassium, 5 parts; red sulphuret of arsenic, 2 parts; ferrocyanide of potassium (prussiate of potash), 1 part; as No. 1.

3. (POWDER No. 3.) Chlorate of potassium and ferrocyanide of potassium, equal parts.

Obs. These compounds are not permanently injured by either salt or fresh water, merely requiring to be dried to regain their explosive character. They possess fully eight times the force of ordinary gunpowder. One of their advantages, especially to the underground miner, is the very trifling amount of smoke produced by their explosion. On the other hand, the extreme facility with which they explode by attrition, contact with a strong acid, and a slight elevation of temperature, render them unsuited to most of the purposes of ordinary gunpowder. On this account they should only be prepared in small quantities at a time, and with the utmost caution. Mr Callow, the inventor of them, lost several of his fingers, and was rendered a cripple for life by an explosion of the kind referred to, which occurred only a few weeks after the sealing of his patent. A straw, or small strip of wood, only slightly wetted with oil of vitriol, and applied to a small heap of the powder, produces instantaneous explosion. Captain Wynand's 'Saxifragine' is composed of nitrate of baryta, 76 parts; charcoal, 22 parts; and nitre, 2 parts. Schultze's wood-gunpowder is composed of granulated wood treated with a mixture of nitric and sulphuric acid, afterwards impregnated with a solution of nitre. M. Bäudish has invented a method by which this wood-gunpowder may be compressed into a solid substance, exerting great power and free from danger by transport. Lithofracteur, a white blasting powder used in Belgium, is a substance similar to gun-cotton.

Messrs Neumayer and Fehleisen's haloxylin is composed of charcoal, nitre, and yellow prussiate of potash. See BELLITE, DYNAMITE, GUN-COTTON, GUNPOWDER, MINING, &c.

BLATTA ORIENTALIS. The common cockroach, originally imported from the East, belongs to the family of orthopterous insects; and may be classed amongst the most offensive and objectionable of domestic pests. It is extremely voracious, not only devouring all kinds of provisions, but attacking and consequently destroying silk, flannel, and even cotton fabrics, in the absence of anything more eatable. The cockroach is nocturnal in its habits, and exceedingly active and swift of movement. Its flattened form enables it to insinuate itself easily into crevices, and so to escape detection. The American cockroach (*Blatta Americana*) is larger than the above. A still larger species (*Blatta gigantea*) is found in the West Indies, where it is known by the name of the drummer. It is so called from the tapping noise it makes on wood, the sound so produced, when joined in by several of the creatures (as it usually is), being sufficient to destroy the slumbers of a household.

Cockroaches may be poisoned by means of wafers made of red lead, or caught by smearing a piece of wood with treacle, and floating it on a broad basin of water. When the fires and lights are extinguished they issue from their holes, and fall into the basin in their efforts to reach the bait. An excellent plan is to place a pie-dish with a little stale beer at the bottom, and pieces of firewood laid from its edge to the floor, near the haunts of the cockroaches; they are attracted by the smell of the beer, climb up the sticks, fall into the basin and, being unable to get out again, are drowned. The chinks and holes from which they come should also be filled up with unslaked lime, and some lime should also be sprinkled about the ground. The simplest and most effectual method is to lay narrow rows of the powder of the flowers of a composite plant, *Pyrethrum roseum,* near the holes from which they issue. Contact with this powder is slow but certain death to them, and a few ounces of the powder judiciously used will destroy thousands in a night. Persian insect powder is commonly composed of the above flowers.

Old Gerrard says they avoid any place in which the leaves of the mullein are strewn about.

The *Blatta Orientalis,* which was formerly supposed to possess remedial powers, and was hence employed in medicine by the more ancient therapeutists, has lately found advocates for his readmission into the animal materia medica. He is reported, when made into a tincture, to act as a diuretic, and to yield a crystalline body possessed of similar properties, but in a more concentrated form. Some of the American journals report that he may be given in the form of powder or infusion (from 15 to 30 gr.) 3 or 4 times a day, in dropsy, and to increase the secretion of urine as well as of perspiration.

BLEACH'ING. *Syn.* BLANCHIMENT, BLANCHISSAGE, Fr.; BLEICHEN, BLEICHEREI, Ger. The process by which the textile filaments, cotton, flax, hemp, wool, silk, and the cloths made of them, as well as various vegetable and animal substances, are deprived of their natural colour and rendered nearly or altogether white.

The art of bleaching is extremely ancient, having been practised in prehistoric times. The earliest processes of which we have any record consisted in steeping the materials in an alkaline or ammoniacal lye, and then exposing them in the sun, and repeating the process as often as was necessary. In the last century Holland obtained the best name for bleaching, and it was even customary to send goods from this country to be bleached there. From Holland the process passed to Ireland and Scotland, and thence into England, the first attempt to vie with Holland being made in Scotland in 1749. The Dutch process may be shortly described as follows: The linen was first steeped in potash lye which had been already used, and then in fresh, boiling-hot lye, in which it was left for eight days. It was then washed

and steeped for days in buttermilk until it was sufficiently white, after which it was again washed and spread out upon the grass to bleach. This was repeated 4 or 5 times, or until the goods were pure, the whole operation lasting from May to September. Since the application of chlorine to bleaching about the beginning of this century the whole art has been revolutionised, what had formerly taken months to accomplish being now completed in a few days. Chloride of lime, which is still preferred as a bleaching agent to all other preparations, was introduced in 1798 by Mr Charles Tennant, of Glasgow, and in 1828 Mr David Bentley, of Pendleton, obtained a patent for the so-called 'continuous process' of bleaching, which is still in general use in all the chief bleach-works of Lancashire.

The processes of bleaching at present in vogue vary somewhat with the material to be operated upon, and will be described below in connection with these materials.

I. Cotton Bleaching. The pieces of cotton cloth are first STAMPED, in order that they may be recognised after having been bleached. They are next STITCHED together so as to form a ribbon, and the ribbons are SINGED so as to remove the light down, consisting of the ends of the cotton fibre, which the cloth retains on its surface. This, if not removed, would interfere with the formation of clean prints in the subsequent process of printing the cloth. The singeing is usually carried out by means of a gas singeing machine, in which the goods are passed rapidly (at the rate of 5000 yards per hour) over a series of *Bunsen* burners arranged in a line. As a rule they are singed twice on each side, and are afterwards wetted in order to extinguish any burning filaments. The ribbons are now crushed into ropes by passing them through a smooth aperture with a surface of glass or porcelain. (In the continuous process of bleaching, these ropes are drawn through one after another of the different baths employed in the process). The goods are now thoroughly washed in the washing machine, and then allowed to steep or lie in a heap all night, whereby a kind of fermentation sets in, which allows the sizing materials to be removed; if the pieces are heavily sized, it is well to give a second washing before the:

LIMING, which consists in passing the pieces in a continuous manner through milk of lime, the consistency of which has been so arranged that the cloth takes up about 5% of lime to the weight of cotton.

SCOURING or BOILING (also *bucking* or *bowking*). The pieces are then brought into strong iron vessels termed 'kiers,' in which they are carefully packed. These kiers are provided with arrangements for effecting a circulation of the liquor, which, after running down through the mass of cloth, is pumped up and again poured through a sprinkler on to the top of the mass. Usually the kiers are closed and are worked by steam, the pressure being 8 to 10 lbs. per square inch in the low-pressure kiers; while some work at 35 lbs. pressure, others even go so high as 50 lbs. If no pressure is used the kiers may be open, but care must then be taken that no cloth is left out of the liquor and exposed to the air during the boiling with lime, or it will become tender, and in some cases even completely rotten. The proportion of lime employed in this operation varies considerably, and is less when working under high than under low pressure. In the former case some bleachers employ 6 hours, some more; some go up to the required pressure in the evening, stop the steam, and leave the pressure to go down of itself, taking out the goods the next morning; while others boil their cloth for 8 or 10 hours at a moderate pressure, and then run off the liquor, adding cold water to the goods in the kiers before removing them. The pieces are now subjected to a:

WASHING, through an ordinary machine, in order to remove the lime and impurities which may still be attached to the cloth. Then follows the:

SOURING, to effect which the cloth is drawn through a bath of muriatic acid, of about 1°—2° Tw., contained in a long stone or wooden cistern; on coming out of this it passes between two rollers, so that the liquor is squeezed out of it and falls back into the cistern. It is now subjected to a thorough:

WASHING, which is performed twice by passing the cloth in succession through two mangles or washing machines. The pieces are then again brought into the kiers and exposed to another:

BOILING or scouring, with soda ash and resin soap. The bath is made by boiling 5 to 6 *lbs.* soda ash and $1\frac{1}{2}$ to 2 *lbs.* resin (colophonium) for 5 or 6 hours with 2 galls. water, the above amounts being taken for every 100 *lbs.* of cloth. The solution so obtained is used in the kiers with about 1 gall. of water for every 1 *lb.* of cloth. This scouring is continued for 5 or 6 hours at 35 to 40 lbs. pressure; with low pressure kiers, at 8 to 10 lbs. pressure, 10 or 12 hours are required, while in the improved injector kiers 3 to 4 hours at 50 lbs. pressure are said to be sufficient. Some bleachers use no resin, and employ caustic soda instead of the carbonate. After this boiling the liquor is run off, and the goods are subjected to another:

BOILING, with about 1% soda ash to the weight of the cloth, for 2 or 3 hours. Then follows a thorough:

WASHING, after which the goods are ready for the real bleaching process, which is generally called *chemicking*.

BLEACHING is performed by immersing the cloth in a solution of 'chloride of lime,' which is either bought ready made, or made in the bleach works by treating bleaching powder with water. The strength of the solution employed varies from $\frac{1}{4}$°—2° Tw.; it is applied cold, or may be heated to 20° or 25° C. (68° or 77° F.), when it penetrates the cotton better. The method of application of the bleaching liquor also varies considerably; in some cases open cisterns are employed, in which the cloth is immersed and allowed to lie for several hours, and in other cases cisterns are used with mechanical arrangements for effecting a circulation; but as a rule mangles are now employed for the purpose. Close to these are placed cisterns in which the pieces are laid after treating with bleaching liquor, and allowed to stand for 2 or 3 hours. Then follows a good:

WASHING (which is sometimes omitted), and then the:

SOURING (white sours) through sulphuric acid at 2° Tw. This is followed by a thorough:

WASHING, in which all traces of acid must be removed, and then comes the:

OPENING up of the pieces, and the:

DRYING of them, principally on cylinders heated by steam.

If the goods are intended for printing, they must then be passed through the:

SHEARING machine, in order to shear off any of the down or filaments brought out during the different operations, or not quite removed by the previous singeing process.

It must be observed that all large bleach works have, along with the mangles or machines for doing the different operations of washing, souring, or chemicking, large stone cisterns in which to keep the cloth after coming out of one operation and before being exposed to another.

For a MARKET BLEACH the following course of operations has been successfully employed in Lancashire works for producing very good whites: 1, lime boil or stew; 2, wash; 3, sour; 4, wash; 5, soda ash boil; 6, wash; 7, chemick; 8, wash; 9, sour; 10, wash; 11, soda ash boil; 12, wash; 13, chemick; 14, wash; 15, sour; 16, wash and dry. In market bleaching the goods are afterwards finished, and in this case an important part is played by the blueing, or tinting, in order to counteract the faint yellow tinge acquired in bleaching.

Cotton yarn is bleached in much the same manner as cotton cloth, but the process is somewhat simpler, as yarn is much more easily freed from impurities than cloth, which contains a large amount of size added to the yarn before weaving. Cotton yarn loses about 5%, and cotton cloth from 20% to 30% of its weight in the process of bleaching.

Weak mineral acids of the strength used in bleaching do not injure the cotton fibre when in in the cold, but they do when heated. Weak alkalies have no injurious effect upon it, even at the boil and under pressure. Milk of lime is also not injurious, even when boiling and under great pressure, but it would exert a destructive action if the material, while being boiled in it, were exposed to the air by protruding from the vessel. Care must be taken that the cloth is freed from every trace of acid before being dried, otherwise it will then become quite rotten. As regards the acids used in the souring operation, hydrochloric acid is to be preferred to sulphuric when it can be obtained cheaply, for the calcium chloride formed when it is used is much more soluble and easily removed than the calcium sulphate which is formed when sulphuric acid is employed.

II. **Linen Bleaching.** The fibre of flax is much more sensitive than that of cotton, and a more tedious and complicated process has to be employed in bleaching it. Great care must be taken in treating linen with chlorine liquors, otherwise the fibre may be easily damaged, and in some cases become completely rotten. Exposure of the goods to the air by spreading them upon grass in the fields—called 'grassing' or 'crofting'—forms an important part of the bleaching of linen; indeed, the old method consisted mainly in boiling the goods with potash lye, rinsing them, and exposing them for weeks on the grass, the process being repeated till the flax was completely bleached. The modern method is described below. The apparatus used is similar to that employed in the case of cotton.

Linen Yarn. For every 100 *lbs.* cloth:

1. Boil with 8 to 10 *lbs.* soda ash, or 5 to 6 *lbs.* caustic soda, for 3 to 6 hours in low-pressure kiers.
2. Expose to the action of bleaching liquor of strength $\frac{1}{2}$° Tw. for 1 hour, by working on sticks in ordinary dye-becks or on reels; then wash.
3. Give acid bath in sulphuric acid of 1° Tw., and, after working until yarns are thoroughly imbibed, immerse in bath for 1 hour, then take out and wash.
4. Boil a second time in kier with 3% to 4% carbonate of soda, or 2 *lbs.* caustic soda; wash.
5. Treat again with bleaching liquor and wash.
6. Pass through acid at 1° Tw. as mentioned before; wash well.

A half-bleach only is obtained by this method. If a thorough bleaching is required, the yarns are exposed 2 or 3 times to the same processes until they become perfectly white. As a rule, after the third boiling with alkalies, the yarns are exposed in the fields for a week and then submitted to the other operations.

Linen Cloth. But few improvements have been made in the bleaching of linen cloth, which takes nearly as long to accomplish as it did twenty years ago; and the superior whiteness of the modern linen goods is gained at the expense of their durability, as the fibre is more or less injured. Below is appended a short sketch of the process, the quantities given being those used per 100 *lbs.* cloth. The apparatus is similar to that used in the case of cotton goods.

1. Boil with 8 to 10 *lbs.* lime for 12 to 14 hours; wash.
2. Hydrochloric acid bath, $2\frac{1}{2}$° Tw.; leave in cistern for 6 hours; wash.
3. Boil 10 hours with resin soap, prepared with 2 *lbs.* dry caustic soda and 2 *lbs.* resin previously boiled together with the amount of water necessary to dissolve them. After running off the liquor, there follows another boiling with 1 *lb.* caustic soda for 7 hours; wash.
4. Expose in the fields for about a week.
5. Bleaching powder liquor, $\frac{1}{2}$° Tw., 5 hours; wash.
6. Acid bath, 1° Tw., 2 hours; wash.
7. Boil for 5 hours with $\frac{1}{2}$ to $\frac{3}{4}$ *lb.* caustic soda; wash.
8. Expose in the fields for 4 to 5 days.
9. Bleaching liquor, $\frac{1}{4}$° Tw., 5 days; wash.
10. Rub with soft soap.
11. Expose in the fields.

This is followed, if necessary, by another bleaching bath, a souring, and a final wash. For linen bleaching the hypochlorites of magnesium or sodium (made by adding the requisite amounts of sulphate of magnesia or of soda ash to the solution of bleaching powder) are preferable to the lime salt, as they are not so severe in their action.

III. **Silk Bleaching.** Silk contains a large

amount of gum, and by getting rid of more or less of this gum different varieties of silk are produced.

Boiled-off Silk. 1. The silk is boiled several times in soap solution heated to 90° or 95° C. (194° or 203° F.). It loses its gum and acquires softness and lustre, but at the same time loses also 28% to 30% of its weight.

2. The bleaching is effected by exposing the goods in the wet state to the vapours of burning sulphur in closed chambers for about 6 hours, the operation being repeated several times until a good white is obtained. A solution of aqua regia is sometimes used as the bleaching agent.

Souple Silk. This is not completely deprived of its gum, and only loses 5% to 8% of its weight.

1. 'Softening:' Work 1 to 2 hours in 10% soap solution at 30°—35° C. (86°—95° F.).

2. 'Bleaching:' Work for 10 to 15 minutes in stone vessels containing solution of aqua regia, 40° Tw., at 25°—30° C. Wash well.

(Aqua regia is prepared by mixing 5 parts hydrochloric acid, 32° Tw., with 1 part nitric acid, 62° Tw.).

3. 'Stoving:' with sulphurous acid in a closed chamber.

4. 'Soupling:' Work 1½ hours in water containing 3 to 4 gr. cream of tartar per litre. Silk so treated is very well adapted for dyeing.

Ecru Silk is the fibre deprived of its gum to the extent of about 2% to 5% by washing or light soaping, and then sulphuring.

Tussah Silk is bleached with peroxide of hydrogen, after being first well cleansed with a soap solution.

In the case of silk a final blueing or tinting is necessary. This is generally done by means of methyl violet of a very blue shade.

IV. **Wool Bleaching.** Wool contains a large amount of a natural varnish called the yolk or suint, and this has to be removed and all impurities eliminated if the wool is to be dyed in the unspun state, as is often the case. The loose wool is first steeped in water in successive tanks, and is thus deprived of most of the yolk. It is then *scoured* by means of alkalies, principally carbonate of soda, or soft potash soap. The temperature is never allowed to go very high, especially for good qualities of wool. For these soda crystals, or at all events a carbonate of soda perfectly free from caustic soda are employed, at a temperature of 40° C. (104° F). Ammonia and also carbonate of ammonia have been used, but their price is high. If soap is used, a 3% to 5% solution gives good results, while a soda solution is generally employed at 1°—2° Tw. Lately volatile solvents such as benzene, petroleum spirit, and bisulphide of carbon have been recommended for extracting grease from raw wool, and have been found very useful in some cases. Their employment is, however, attended by great danger of fire.

In scouring yarn it must be remembered that it contains about 10% to 15% of oil, which was added previous to spinning. The operation is often performed by means of scouring machines, the hanks being linked together in the form of a chain. Woollen cloth is also scoured on machines in a continuous way.

The wool is now *washed* in a solution containing 2 *lbs.* of potash soap (made on the premises from potash and cotton-seed oil), and ¼ *lb.* refined carbonate of potash to the gallon of water, the average consumption being 19 *lbs.* potash soap and 2½ *lbs.* carbonate of potash per 240 *lbs.* of wool. It is very important that the temperature should be kept low—no higher than the hand can bear, and that no soda salt should be used. The washing is advantageously performed in a washing machine.

The *bleaching* is effected by means of sulphurous acid, principally by exposing the wet goods to the vapour of burning sulphur in closed chambers; of late years also by the employment of bisulphites, principally bisulphite of soda and hydrochloric acid, either in the same or in two separate baths. Were it not for its high price, hydrogen peroxide would be the best bleaching agent.

The following series of operations is often employed:

For 40 pieces of 20 to 30 yards each:

1. Singeing.
2. Pass three times through bath containing 11 to 12 *lbs.* soda crystals, and 5 to 6 *lbs.* soda in 6 to 7 galls. of water, heated to about 40° C. (104° F.). After each passage through the baths add 4 to 8 *oz.* soap.
3. Rinse in two clean waters of the same temperature.
4. Run again three times through a bath similar to the first, but without soap, and add after the first passage 4 *oz.* more soda.
5. Sulphur for 12 hours in the chamber by burning 11 to 12 *lbs.* sulphur.
6. Run again three times through bath containing 13 to 14 *lbs.* soda in 6 to 7 galls. water at a temperature of about 50° C. (122° F.), adding ¼ *lb.* more soda after every passage.
7. Second sulphuring as before.
8. Repeat No. 6.
9. Wash in two waters at 30° (86° F.).
10. Third sulphuring for 12 hours.
11. Wash twice in lukewarm and once in cold water.
12. Finally blue with indigo carmine.

These operations are generally sufficient for ordinary woollens; if they contain much colouring matter, or if they are destined for fine colours, the process is as follows:

1. Singeing and washing in water.
2. Pass through alkaline soap containing 11 to 11½ *lbs.* soda crystals and 4 to 5 *lbs.* soap in 6 to 7 galls. water at a temperature of 60°—70° C. (140° to 158° F.).
3. Rinse in warm water.
4. Give two passages through a bath like No. 2, but without soap, at the same temperature.
5. Wash once in warm water.
6. Sulphur for 10 hours with 11 to 12 *lbs.* sulphur per 25 pieces.
7. Wash once.
8. Pass twice through a bath of 7 to 7½ *lbs.* soda in 6 to 7 galls. water at 60°—70° C.
9. Run twice through a bath of 6 *lbs.* soda in 6 to 7 galls. water at 60°—70° C.
10. Wash once in warm water.
11. Sulphur again with 8 *lbs.* sulphur per 25 pieces of goods.

12. Wash once, and:

13. Blue with indigo carmine or extract.

Raw wool loses from 35% to 45% of its weight by scouring, and 1% to 2% more in the subsequent operations of the bleacher, the loss being in direct proportion to the fineness of the staple.

The above are the four principal applications of the art of bleaching; but, in technical language, the words bleaching, bleacher, bleachery. bleach-works, &c., when employed alone, are understood to have reference only to cotton and linen. This has arisen from the enormous extent of these manufactures, and because the process of bleaching those substances forms a business entirely distinct from that of weaving, dyeing, or printing them. The following, with the exception of the first, are of comparatively minor importance and interest:

V. Materials for Paper. Old rags for the manufacture of paper and paper-pulp are now almost universally bleached by chlorine or chloride of lime, the former being generally used in France and the latter in England. The process usually consists in (1) boiling in an alkaline lye to remove grease and dirt, (2) washing, (3) pressing, (4) devilling or tearing up the pressed cake into fine shreds or pulp, (5) chemicking, with agitation, for about an hour, in a clear solution of chloride of lime, followed by (6) washing, (7) souring with dilute hydrochloric acid at 1° or 2° Tw., or treatment with a solution of some antichlor, or both, and (8) a final washing and pressing. For the common kinds of paper, the operations included in No. 7 are omitted; but unless the whole of the lime-salt is removed from the pulp, the paper made of it is liable to turn brown and to become rotten by age. In some cases rags are bleached before being divided and pulped. Cotton-waste is bleached in a similar way to rags.

In France the chlorine, in a gaseous form, is passed from the generators into the bleach-cisterns containing the pulp, which in this case must be fitted with close covers.

VI. Printed Paper, *e.g.* Books, Engravings, Maps, &c. These, when stained or discoloured, may be whitened by (1) wetting them with pure clean water, (2) plunging them into a dilute solution of chlorinated lime, (3) passing them through water soured with hydrochloric or oxalic acid, and then (4) through pure water until every trace of acid is removed. This process may be still improved upon by further dipping them into a weak solution of some antichlor, and again washing before finally drying them. It is only rare and valuable original works or specimens of art that are worth this treatment, which, owing to the very nature of paper, requires considerable address to manage. In many cases a sufficient degree of renovation may be effected by simply exposing the articles, previously slightly moistened, to the fumes of burning sulphur, and subsequently passing them through a vessel of pure water. Hydrogen peroxide is now also employed in restoring the colours to faded pictures.

VII. Straw, Straw-plait, and articles made of them are, on the large scale, usually bleached by (1) a hot steep or boil in a weak solution of caustic soda, or a stronger one of soda-ash, followed (2) by washing, and (3) by exposure to the fumes of burning sulphur. To effect the last, the goods are suspended in a close chamber, connected with a small stove, in which brimstone is kept burning. On the small scale, a large chest or box is commonly employed. A piece of brick, or an old box-iron heater, heated to dull redness, is placed at the bottom of an iron crock or earthen pan, a few fragments of roll sulphur thrown on, the lid instantly closed, and the whole left for some hours. Care should be taken to avoid inhaling the fumes, which are very deleterious as well as disagreeable and annoying. Straw goods are now also frequently bleached by the use of a weak solution of chloride of lime, or of water strongly soured with oxalic acid or even oil of vitriol, followed by very careful rinsing in clean water; but here, as in the former case, the natural varnish, dirt, grease, &c., must first be removed by alkalies or soap, to enable the chlorine or acid to act on the fibres.

VIII. Wax. Wax is bleached by melting it at a low temperature in a cauldron, from whence it is allowed to run out by a pipe at the bottom into a capacious vessel filled with cold water.

This vessel is fitted with a large wooden cylinder which turns upon its axis, and the melted wax falls upon this cylinder. The surface of the cylinder being always wet, the wax does not adhere to it, but becomes solid, assuming the form of ribbons as it does so, and in this shape becoming distributed through water in the tub. The wax is then removed and placed upon large frames stretched upon linen cloth, which are supported about 18 inches above the ground, and erected in a situation exposed to the air, dew, and sun. If the weather be favourable the wax will become white in a few days. It is again remelted, formed into ribbons, and exposed as before. These operations are repeated until the wax is completely bleached, after which it is melted and run into moulds. The loss of weight caused by bleaching is from 2% to 10%. The process may be much accelerated by previously melting the yellow wax with 1-8th to 1-5th of its weight of rectified oil of turpentine. The bleaching is then finished in from 5 to 6 days, by which time the smell of turpentine has entirely disappeared.

A short account will now be given of a few of the more important bleaching processes which have been recently introduced, but have not yet become generally employed.

The Mather-Thompson Process. The pieces are stitched together and formed into a rope, and this is treated with a solution of caustic soda which has been previously used in the 'steamer kier' (see *below*). It is then washed, and folded into large cages of galvanised iron lattice-work, and these are run on rails into a large horizontal boiler termed the 'steamer kier,' which is capable of holding two of the cages at a time. In this, by means of a pump and a sprinkling arrangement, the cloth is kept continually wetted with a solution of caustic soda of strength 2°—4° Tw.; steam is employed in the kier at a pressure of 4 lbs. to the square inch, and the operation lasts 5 hours. The liquor is then run off into a cistern below, and the kier is filled with hot water, which is kept in circulation by means of a pump, and thus washes the material. The water is

then run off, the cages are removed, and the cloth rinsed with cold water, the scouring being now complete. The cages are now brought to the bleaching apparatus, in which the ropes are run, in the continuous way, through a series of troughs arranged in the following order:

1. Rinsing with hot water.
2. First chemick bath.
3. Passage through carbonic acid chamber.
4. Washing.
5. Scalding with soda ash.
6. Washing.
7. Second chemick.
8. Carbonic acid passage.
9. Wash.
10. Sour with hydrochloric acid.
11. Wash well and finish.

The cloth passes through the machine at the rate of 60 yards per minute. The novelty of this process is the use of carbonic acid, which decomposes the calcium hypochlorite forming hypochlorous acid, the latter substance effecting the bleaching. Carbonate of lime is, however, precipitated on the fibre, and must be removed by a bath of hydrochloric acid. A very quick bleach is effected by this method, as cloth only takes about 10 to 12 hours to go through the different operations, and a saving is effected in the amount of water used,—an important consideration with bleachers who do not enjoy an unlimited supply of water. The cloth is also not punished so much as in the old process, but, although a good bleach for ordinary printing may be obtained by this method, the result is not quite so satisfactory for a madder bleach, although the process might doubtless be modified so as to overcome this difficulty.

Lunge's Process. The peculiarity in this process consists in the use of acetic acid. Only a small quantity of this is required, as it is continually regenerated in the process, and hence its high price is no obstacle to its employment. It reacts with the 'chloride of lime,' forming calcium acetate and hypochlorous acid. This latter substance gives up its oxygen to bleach the fibre, and becomes reduced to hydrochloric acid, which at once reacts with the calcium acetate previously formed, yielding calcium chloride and regenerating acetic acid. Thus there is never any free hydrochloric acid in the solution, and the cloth is therefore less likely to be injured than in the ordinary process, for acetic acid, unlike hydrochloric, does not damage the fibre even at a comparatively high temperature. There are, moreover, no insoluble calcium salts formed in this process, and hence the operation of souring is unnecessary. The acetic acid may be added to the bleaching liquor, or employed as a bath after the latter, or it may be added to some water which is made to circulate over the bleaching material, and in which the goods to be bleached are immersed. The process is suitable for the bleaching of vegetable fibrous materials, either in the loose (raw) state, or as yarn or cloth, and also for the bleaching of some coloured goods, such as alizarin-red and other coloured materials.

Hermite's Process. Many different methods have been proposed for the manufacture of a bleaching liquor by the electrolysis of solutions of chlorides, such as magnesium or sodium chloride. Of these the most successful is that introduced by M. Hermite, in which a dilute solution of magnesium chloride is electrolysed, conveyed to the bleaching tank and allowed to act on the cloth, and then again brought back to the first tank, where it is again electrolysed and its bleaching properties renewed. The merits of this process have been much disputed, and it may be doubted if it will attain commercial success. It was shown in operation at the recent Exhibition at Antwerp.

Bleaching by Oxygen directly. This has probably a great future before it. The manufacture of oxygen on the large scale (see OXYGEN) has only quite recently become a commercial success, but Dr Thorne, chemist and manager to Brin's Oxygen Company, London, has already made some most interesting experiments, on a technical scale, upon direct bleaching by oxygen (see 'Chem. Ind. Journ.,' Feb., 1889).

With regard to the theory of the bleaching process there is little to be said, for it is still but very imperfectly understood. The current opinion is that it is the nascent oxygen which is liberated that effects the bleaching, but there are some who assert that the chlorine in the bleaching agent also plays an important part, and this is to some extent confirmed by the fact that bleaching with hydrogen peroxide takes very much longer than bleaching with hypochlorites. One authority even states that he has detected chlorine in a piece of bleached cloth. Sulphurous acid acts in a different way to all other bleaching agents, for it bleaches by reduction and not by oxidation, and the bleach produced by it is not absolutely permanent.

Bleaching Agents. Of these many have been tried, but as yet none have been produced at a sufficiently low price to enable them to compete with 'chloride of lime,' which is at present universally used as a bleaching agent. For special purposes hydrogen peroxide, sulphurous acid, and the hypochlorites of sodium and magnesium are occasionally used. Below is given a list of some bleaching agents, with the cost of that quantity of each which is capable of yielding 16 tons of available oxygen.

Bleaching powder . .	£1000
Potassium chlorate . .	1500
Potassium permanganate .	2550
Potassium bichromate .	5495
Barium peroxide . .	24,167
Hydrogen peroxide . .	74,800
Potassium ferrocyanide .	131,600

Bleaching Powder. This is the so-called 'chloride of lime,' in reality a compound of calcium chloride and hypochlorite, but containing also water and free lime. It is manufactured by passing chlorine over slaked lime spread into thin layers upon shelves in stone chambers of peculiar construction. It is important that the lime should be pure, and contain the proper amount of water; usually about 5 galls. of water are added to every cwt. of quicklime. The chlorine is made from hydrochloric acid and manganese dioxide (see CHLORINE). The chlorination must be conducted slowly, and the temperature kept pretty low; the time necessary is generally 36 to 48 hours for

14 cwts. of lime, or, under very favourable conditions, 24 to 30 hours. The product contains from 30% to 39% of *available* chlorine; on keeping, some of this becomes no longer *available*, and some carbonic acid is absorbed by the free lime in the powder. (*Note.* By the term *available chlorine* is meant that portion of its chlorine which is liberated from bleaching powder on the addition of an acid, and which is therefore *available* for bleaching.) The bleaching liquor is made by treating the powder with water and siphoning off the solution, which must be perfectly clear.

We must not conclude this article without acknowledging our indebtedness to Mr Sansone, from whose excellent works on Calico Printing and on Dyeing much of the information contained in the article has been derived.

BLEAR′-EYE [blēre-ī]. *Syn.* Lippitu′do, L.; Chassie, Lippitude, Fr. An exudation of a puriform matter from the margins of the eyelids, which are red, tumid, and painful, and frequently during the night glued together by the discharge.

Treatment. Mild astringent collyria, as those of sulphate of zinc or alum (6 or 8 gr. to 1 oz. of water). An ointment formed of 1 part of the ointment of nitrate of mercury (Ph. B.), diluted with 7 parts of sweet washed lard or vaseline, may be advantageously applied nightly by means of a camel-hair pencil, the smallest quantity possible only being used. Excess in eating and drinking should be avoided, and some aperient medicine taken.

BLEAK (blēke). *Syn.* Blay‡, Bley‡ (blā). The *Cypri′nus albur′nus*, Linn., a small river-fish, the scales of which are used in making artificial pearls (which *see*).

BLEBS. *Syn.* Bullæ. A vesicle or blister. A generic term, generally used to signify a collection of fluid beneath the true epidermis. This fluid may be clear and transparent, milky, or tinged with blood, but not pus. Bullæ arise from numerous causes, and their treatment varies accordingly. See Burns and Scalds.

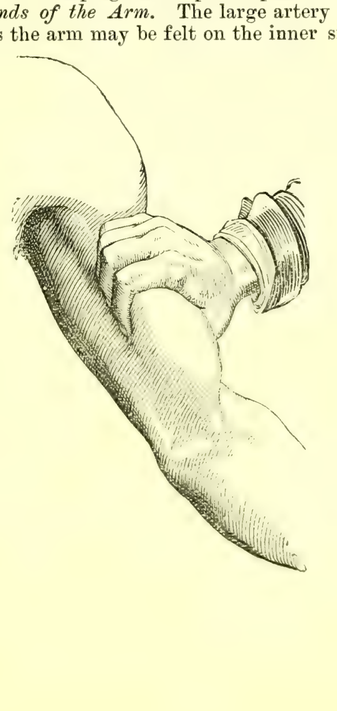
BLEEDING, or HÆMORRHAGE. The flow of blood from a wound is of three kinds—arterial, venous, and capillary. Capillary bleeding is an oozing of blood from an abraded or inflamed surface; its importance will, therefore, depend very largely upon the extent of the injury. Venous bleeding is continuous and steady, and the loss of blood may be great, as from an injured varicose vein. Arterial bleeding is the most dangerous; the blood is a bright red, and spurts from the wounded vessel with considerable force. If the artery be a large one, the flow is in jerks corresponding with the action of the heart.

Treatment of bleeding. In cases of accident no notice should be taken of the kind of bleeding: the important thing is to stop it, and to stop it as quickly as possible. The position of the patient is important, for blood will not run uphill, and therefore much may be done by simply raising the injured part; in this way an obstacle is at once presented to the flow. In cases of capillary bleeding, the application of cold in the shape of ice or cold water is often very effectual; but it may be necessary to apply more active astringents, such as perchloride of iron, alum, or tannin. The simplest plan is, when the surface is considerable, to place a pad of wet lint over it and to strap it tightly into its place by means of a bandage. The pressure is in this way distributed, and the bleeding very effectually checked. It may be necessary to change the lint once or twice as it becomes soaked with blood, and if the bleeding still continues, astringents should be used in addition.

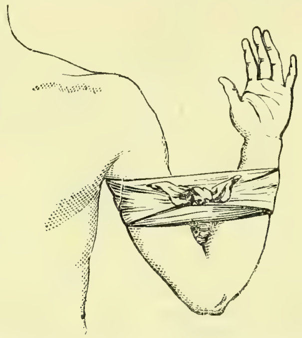
Bleeding from wounds is often apparently very alarming, and it is well to remember that, even when an artery of considerable size has been severed, it is possible to control the flow of blood, if not to stop it entirely, by simply placing the finger upon the point from which it flows. Very slight pressure is required; and in this way loss of blood can be prevented until assistance can be procured. Lacerated wounds do not, as a rule, bleed so freely as incised wounds, because the inner elastic coat of the arteries when torn curls up and presents a number of ragged points, which greatly facilitate the coagulation of the blood. The bleeding is, however, liable to commence afresh if the part be moved.

Wounds of the head are of frequent occurrence, and no matter how caused have generally the character of an incised wound. The bleeding should be stopped by compression with the finger, and a pad applied over the part and secured in its place with a bandage. A pad may be made of a roll of lint, cotton, tow, &c., or, better still, of a cork or other hard substance wrapped in a handkerchief or other soft material. The figure shows the mode of keeping such a pad in position.

Wounds of the Arm. The large artery which supplies the arm may be felt on the inner side of



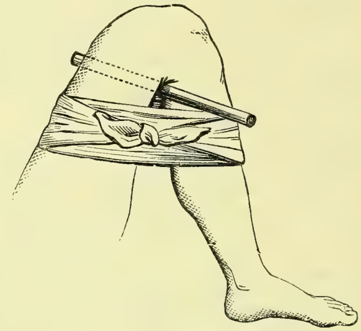
the limb in the armpit. It runs down the inner side of the arm to the elbow, where it divides into two branches which are placed on the inner and outer side of the forearm respectively. The brachial artery may be compressed, as in the figure, by the fingers against the bone, and then a pad made of a large stone or cricket-ball rolled in a handkerchief may be secured in position by means of a bandage, so as to continue the compression; a piece of good india-rubber tubing may be tied round the limb and twisted by means of a short stick until the artery is sufficiently compressed. The next cut shows how bleeding from



the forearm may be controlled by compression of the artery at the bend of the elbow. This is a useful method in the case of deep wounds of the palm of the hand. In such a case, wash the wound well with cold water, make the patient lie down, and raise the whole limb; bandage a pad over the wound and then bending the forearm, as in the figure, apply a bandage to keep it in position.

Wounds of the lower limbs are to be treated in much the same way. The femoral artery may easily be compressed in the thigh by the use of the two thumbs, as in the figure, and any serious

bleeding from its branches below this point controlled. The annexed cut shows how bleeding from the leg may be controlled by compression of the artery at the back of the knee-joint, but as this position is very uncomfortable for the patient it is, perhaps, better to place a good pad behind the joint and hold it in position by means of a bandage. The extreme value of properly applied digital compression cannot be too much insisted upon.



Varicose veins sometimes break and give rise to serious hæmorrhage. In these cases place the patient on his back, raise the limb, and place the thumb or finger on the vessel *below* the point from which it is bleeding, as it must be remembered that in the veins the blood is on its way *to* the heart. It is well to place a pad both above and below the point of rupture in the case of varicose veins, as the vessels are generally so enlarged that the valves which should prevent the backward flow of the blood are useless.

Bleeding from the nose is best treated by the application of cold water to the face, nose, and forehead. It may be necessary in some cases to apply cold water to the interior of the nose by means of a simple nasal douche (see DOUCHE). It is a good plan to make the patient stand against a wall with the hands raised high above the head. In very serious cases it is necessary to plug the nose, but this should only be done by a surgeon.

Bleeding from the lungs should be treated by placing the patient in bed or on a couch, with the head and shoulders raised. Cold water to drink and pieces of ice to suck are often very effective.

Wounds of the abdomen are difficult to handle, and all that should be attempted by unskilled persons is to bathe the wound with water, preferably warm, bring the edges together, and keep them in their place by a strap of plaster; a piece of lint over this and then a large piece of wadding, kept in its place by a broad roller bandage, is all that should be done until skilled assistance can be procured.

General Instructions. In all cases of bleeding, except from the lungs, let the patient lie down flat, stop the bleeding by the use of the fingers, and then apply pads and bandages as above described, remembering that assistance cannot be too promptly given. The simplest dressing for a wound is first to wash it thoroughly with cold water, preferably containing a few drops of carbolic acid, then draw the edges together and keep

them in their place by means of pieces of plaster, which should be attached to the surrounding skin and not to the wound itself; then lay a piece of lint, wrung out in carbolised water or in a solution of boracic acid, upon the wound; more lint over this, and a bandage to keep the whole in place. See WOUNDS.

Bleeding from the Stomach. Hæmatemesis. Keep the patient on his back and in a state of perfect rest, avoiding also all mental excitement. No purgatives or emetics, solid food or stimulants, should on any account be given; fluid food should only be given in very small quantities at a time. Iced drinks and the sucking of ice are serviceable, as is the application of ice to the chest and abdomen. Astringents such as perchloride of iron, sulphuric acid, and tannic acid may be given, but, except in those cases where skilled help cannot be procured, should only be resorted to under the guidance of a physician or surgeon. See DYSENTERY, HÆMORRHAGE, PILES, WOUNDS.

BLENDE (blĕnd). Native sulphide of zinc. See ZINC.

BLIGHT (blīte). See MILDEW, and PLANTS (Diseases of).

BLIMBING, THE (*Averrhoa bilimbi*, Linn.). The fruit of a tree-sorrel cultivated in India and the West Indies, which yields an acid fruit, often pickled.

BLIND'NESS (blīnd'-). *Syn.* ABLEP'SIA CÆ'CITAS, &c., L.; AVEUGLEMENT, CÉCITÉ, Fr.; BLINDHEIT, Ger. Deprivation or want of sight.

Blindness may be congenital, or born with a person; or it may arise from accident, external violence, or disease. In the latter it may frequently be relieved by medical and surgical treatment. See AMAUROSIS, CATARACT, EYES, OPHTHALMIA, VISION, &c.

Blindness, Day. *Syn.* NIGHT'-SIGHT; NYCTALO'PIA, L. A disease of the eye in which vision is painfully acute or more or less extinct in a strong light, as that of day; but clear and pleasant in the dusk of evening and at night. Its chief causes are excessive exposure of the eyes to the direct influence of very strong or glaring light, or to heat, or both of them together; and is often one of the sequelæ of ophthalmia (which *see*).

Blindness, Night. *Syn.* DAY'-SIGHT; HEMERALO'PIA, L. An affection of the eye, the reverse of the preceding, in which objects are clearly seen only in broad daylight. In the beginning of the complaint the patient continues to be able to see, though less clearly, for a short time after sunset, and even by moonlight, and perhaps distinctly by bright candle-light; but after a short time this power is lost. It most frequently occurs in hot climates and low latitudes at sea. Its chief causes are fatigue and exposure of the eyes to the glare of the tropical sun, probably coupled with gastric derangement. In some cases it is congenital, and is then generally incurable. The treatment consists in avoiding exciting causes, and endeavouring to restore the tone of the stomach, and the general health, by the usual methods. The eyes at the same time should be topically medicated by the frequent use of cold water, or mild astringent collyria. See OPHTHALMIA (Chronic).

There is considerable difference of opinion as to the precise derivation of the two words, nyctalopia and hemeralopia, and great confusion exists as to the correct interpretation of the words. In 'Quain's Dictionary of Medicine' they are used in precisely the opposite senses to those given above, and on one view of their derivation this is perfectly justifiable.

BLISS'S CURE. A nostrum used to relieve attacks of asthma. It may be imitated by mixing powders of nitrate of potassium, lobelia, stramonium, cubebs, and star aniseed.

BLIS'TER. *Syn.* PAP'ULA, PUS'TULA, L.; PUSTULE, VESSIE, &c., Fr.; BLASE, BLATTER, Ger. A bladder or vesicle caused by the deposition of serous fluid between the cuticle and the derma or true skin, occasioned by the application of a vesicant, or by a burn, scald, or friction.

Blister. *Syn.* VESICATO''RIUM, L.; EPISPASTIQUE, VESICATOIRE, Fr.; BLASEN-PFLASTER, B.-STOFF, Ger. A substance which vesicates or raises blisters; in pop. lang., a vesicating plaster or similar application.

The use of blisters is very ancient, and appears to date back long prior to the time of Hippocrates. Indeed, their value as cutaneous stimulants and counter-irritants appears to have been recognised by the medical faculty of all nations down to the present time. It is a principle sufficiently established with regard to the living system, that where a morbid action exists it may often be removed by inducing an action of a different kind, as a state of excitement or irritation, in the same or a neighbouring part. In this way is explained the utility of blisters in local inflammation and spasmodic action, and it is this principle which regulates their application in pneumonia, gastritis, hepatitis, phrenitis, angina, rheumatism, colic, spasmodic affections of the stomach, &c.—diseases in which they are employed with the most marked advantage. A similar principle exists with respect to pain; exciting one pain often relieves another. Hence blisters frequently give relief in neuralgia, toothache, and other like painful affections. Lastly, blisters, by their operation, communicate a stimulus to the whole system, and raise the vigour of the circulation.

Blisters are commonly prepared with cantharides plaster, or with some other preparation of cantharides; and, in the former case, usually have their surface sprinkled over with powdered Spanish fly; whilst the blistering surface is surrounded with a margin spread with common adhesive plaster, for the purpose of causing them to adhere to the part to which they are applied. In order to prevent the action of the cantharides upon the mucous membrane of the bladder, or urinary organs, they are also often sprinkled with a little powdered camphor, or, better still, are moistened with camphorated ether, which, on its evaporation, leaves a thin layer of camphor on the surface; but care must be taken that the layer be not too thick, as in that case the plaster would not take effect. With a like object, a piece of thin book-muslin or tissue-paper (silver-paper) is frequently placed between the blistering surface of the plaster and the skin, the efficacy of which may be still further heightened by first soaking the muslin or paper in olive or almond oil. Blistering collodion

is now much used as a clean and easy method of vesication.

The usual time an ordinary blister of cantharides plaster is allowed to remain in contact with the skin is from 4 to 8 hours. It is then gently removed. The subsequent treatment depends on the object in view. When it is not wished to maintain a discharge from the blistered surface, the vesicle is cut with the point of a pair of scissors at its most depending part, to let out the fluid which it contains, followed by a dressing of spermaceti or other simple ointment; but when the case requires the blister to be kept open, or to be converted into a perpetual blister, as it is sometimes called, the whole of the detached cuticle is carefully removed with the scissors, and the part is dressed with either the ointment of cantharides or of savine, at first more or less diluted with lard or simple ointment, with an occasional dressing of resin cerate. According to Mr Crowther, the blistered surface is best kept clean by daily fomentation with warm water.

Of late years, to obviate the unpleasant effects occasionally arising from the common blister, various compounds having cantharides for their base, as well as fabrics spread with them, have been brought before the public. These are noticed hereafter. See PLASTER, VESICANTS, &c.

Blisters, Extempora″neous. Among the best of these may be mentioned the following:

1. A piece of lint dipped in the strongest vinegar of cantharides, and immediately after its application to the skin, covered over with a piece of strapping, or preferably a piece of sheet gutta percha or oiled silk, to prevent evaporation. Raises a blister in from 5 to 8 minutes.

2. Concentrated acetic acid, applied in the same way, has a similar effect.

3. (*Dr Darcq.*) Into a flat watch-glass pour from 8 to 10 drops of highly concentrated liquor of ammonia; cover the liquid with a small piece of linen of rather less diameter than that of the glass, and at once apply this little apparatus to the previously shaved skin. The whole must be kept in its place by means of moderate pressure with the fingers, until a red ring, about 2 centimetres in breadth, is observed round the glass, when it is certain that vesication is effected. Sometimes scarcely 30 seconds are necessary for obtaining the result. The apparatus may then be removed, and the blistered part treated in the usual manner; the dressing being according to the object in view.

4. (*Trousseau.*) Bibulous paper slightly wetted with a little of the ethereal extract of cantharides, and instantly applied to the skin, the whole being covered with a piece of adhesive plaster to prevent evaporation.

5. Boiling water applied by means of a suitably shaped tube, the adjacent parts being at the same time protected from injury. Instantaneous.

Blister, Horse. See VETERINARY MEDICINES.

Blister*, Perpetu′al. See BLISTER (*antè.*)

BLIS′TERING. *Syn.* VES′ICANS, VESICATO″RIUS, L.; EPISPASTIQUE, VÉSICANT, VÉSICATOIRE, Fr.; BLASENZIEHEND, &c., Ger. In *medicine*, &c., that vesicates or raises blisters when applied to the skin.

Blistering Pa′per, Plas′ter, Tis″sue (tĭsh-ū), &c. See PLASTERS, VESICANTS, &c.

BLOAT′ER. See BLOTE.

BLONDE. [Fr.] *Syn.* BLOND′-LACE. Silk-lace. The name is now also applied to cotton-lace edged with silk. For the mode of cleaning it and getting it up, see LACE and MUSLIN.

BLOOD has been described by Claude Bernard as a medium of exchange between the outer world and the tissues of the body. By means of it our bodies receive oxygen from the air, and into it are poured the products of the digestion of our food to be carried to all parts of the body. The blood performs two great offices: it carries material to the tissues for their growth and repair, and it carries material from the tissues—waste products destined ultimately to be expelled from the body.

Physical Properties. The colour of the blood varies from a bright scarlet in the arteries to a bluish red in the veins. Venous blood, or blood containing a minimum of oxygen is dichroic—that is, it appears dark red by reflected light, and greenish by transmitted light. The reaction of the blood is alkaline, owing to the presence of disodic phosphate, Na_2HPO_4. This may be shown by pricking the finger and allowing the blood to touch a piece of dry, faintly reddened litmus paper; on wiping it off after a few seconds a well-marked blue patch will be left.

Odour. Blood has a peculiar odour which differs in different animals and in man, and is said to depend upon the presence of volatile fatty acids. The taste is saline, and the sp. gr. about 1055. The temperature varies from 97·7° to rather more than 100° F.

Microscopic Characters of the Blood. When blood is examined under the microscope it is seen to consist of a number of corpuscles floating in a transparent fluid. The corpuscles are of two kinds: (1) the red, the more numerous; and (2) the white corpuscles. The human red corpuscles are biconcave, circular, non-nucleated; their diameter is about 1-3500ths of an inch and the thickness about 1-4th of the diameter. Their number has been estimated at upwards of 5,000,000 per c.mm. The method by which the corpuscles of the blood are counted is exceedingly ingenious, and the results obtained are of very great value in determining the progress of certain diseases. The apparatus consists of a cell 1-10th of a mm. in depth, and having its base divided into squares in such a manner that the space over each square is 1-4000th of a c.mm. A drop of blood is then taken in a specially graduated pipette having a bulb which will contain a known amount of an artificial serum or of sodium sulphate solution. The blood and the other solution are mixed in this way in known proportions, and the diluted blood is placed on the cell before described, and the number of corpuscles in each square is counted under the microscope. The degree of dilution being known, it is easy to calculate the number of corpuscles present in a given quantity of blood.

The red corpuscles consist of a framework or stroma, in which the red colouring matter or hæmoglobin is dissolved. When blood is shaken with chloroform, or with certain other reagents,

the hæmoglobin is dissolved out and distributed in the plasma.

Form and Size of the Red Corpuscles in Different Animals. All mammals (with the exception of the camel, llama, alpaca, and their allies) and the cyclostomata among fishes, *e.g.* pteromyzon, possess circular, biconcave, non-nucleated, disc-shaped corpuscles. Elliptical corpuscles without a nucleus are found in the above-named mammals, while all birds, reptiles, amphibians, and fishes (except cyclostomata) have nucleated, elliptical, biconvex corpuscles.

The following table shows the relative sizes of the corpuscles of certain animals in 1000ths of a mm.:

Disc-shaped Corpuscles.

Elephant	9·4
Man	7·7
Dog	7·3
Rabbit	6·9
Cat	6·5
Sheep	5·0
Goat	4·1
Musk deer	2·5

Elliptical Corpuscles.

	Short Diameter	Long Diameter.
Llama	4·0	8·0
Dove	6·5	14·7
Frog	15·7	22·3
Triton	19·5	29·3
Proteus	35·0	58·0

The white corpuscles or leucocytes are colourless, amœboid bodies, highly refractile, capable of movement, and possessing a nucleus. They are of variable size, averaging about 1-2500ths of an inch in diameter. The following table exhibits their relative proportion to the red corpuscles under various conditions, and the effect of age and sex:

Girls	1 : 405	While fasting	1 : 716
Boys	1 : 226	After a meal	1 : 347
Adults	1 : 334	During pregnancy	1 : 281
Old age	1 : 381		

These white corpuscles, under suitable conditions, perform various amœboid movements, altering their form and absorbing small particles of matter in much the same way as an ordinary amœba. These movements are of great importance, inasmuch as by means of them the white corpuscles pass through the walls of the capillaries into the surrounding tissues, probably playing an important part in growth and nutrition. There are a number of forms, intermediate between the red and white corpuscles, found in the marrow of the bones and in the spleen, which probably represent stages in the process of formation and development.

Colouring Matter of the Blood. Hæmoglobin may be obtained from the blood of certain animals, *e.g.* that of the guinea-pig, rat, squirrel, in crystals belonging to the rhombic system. Hæmoglobin exists in two states, viz. oxyhæmoglobin and reduced hæmoglobin. The latter is the state in which it exists in venous blood. The hæmoglobin of arterial blood may be reduced by shaking with a little ammonium sulphide. Reduced hæmoglobin does not crystallise. The plasma may be separated from these corpuscles by preventing coagulation and allowing them to settle. This may be effected in various ways: 1. By tying the jugular vein of a horse immediately after death in two places and cutting the vein above and below the ligatures. If this portion of vein full of blood be suspended in a cool place for a few hours the blood will not coagulate, but will separate into two portions, the corpuscles settling down to the bottom of the tube; the plasma may then be removed by means of a pipette. 2. By drawing blood from a vessel into a strong solution of magnesic sulphate, this will also prevent coagulation and allow the corpuscles to separate from the plasma. Blood kept at or about the freezing point will not coagulate, and the corpuscles will settle down as in the previous cases.

The following tables show approximately the composition of the blood and of some of its more important constituents:

Analysis of Blood.

1000 parts by weight of horses' blood contain:
344·18 blood-corpuscles containing about 12·8% of solids.
655·82 plasma containing about 1% of solids.

1000 parts by weight of moist blood-corpuscles contain:

	Pig.	Ox.
Solids	367·9	400·1
Water	632·1	599·9

The solids are:

	Pig.	Ox.
Hæmoglobin	261·0	280·5
Albumin	86·1	107·0
Lecithin, cholesterin and other organic bodies	12·0	7·5
Inorganic salts	8·9	4·8
Potash	5·543	0·747
Magnesia	0·158	0·017
Chlorine	1·504	1·635
Phosphoric acid	2·067	0·703
Soda	0·00	2·093

(*Bunge*)

Approximate Composition of Human Blood as a whole.

Water 780 (in 1000 parts)
Solids, of these:

Corpuscles	134	220
Serum albumin, Serum globulin	70	
Fibrin of clot	2·2	
Inorganic salts (of serum)	6·0	
Extractives	6·4	
Fatty matters	1·4	
Gases O,Co,N.		

The Phenomena of Coagulation. If blood be allowed to flow from a vein or artery into a clean glass vessel the following series of events will take place: For a short time, depending greatly on the temperature of the place in which the experiment is conducted, the blood will remain fluid; it will then become apparently viscid, and on attempting to pour it out from the vessel it will be found to have become more or less gelatinous. This increases for a time until the vessel may be turned upside down without the blood running out. The next stage is marked by a gradually

increasing concavity of the upper surface of the mass on which, after a time, drops of a clear straw-coloured fluid will appear, and gradually increasing in number, will run together and form a pool in the centre of the concave surface. As this proceeds it will be noticed that the whole mass is slowly contracting and leaving the walls of the containing vessel, until at length it separates into two distinct parts, a solid and a liquid portion; the solid part is the clot and the liquid the serum. If left to itself the process of contraction goes on until the clot, which is a perfect cast of the interior of the vessel, floats in the serum and diminishes very greatly in size. The clot consists of the corpuscles entangled in the meshes of a fibrous material, the fibrin. If the clot be well washed in water containing a little common salt, the corpuscles may be washed out and the fibrin obtained as a white, glutinous, elastic mass of threads or fibres. A better way of obtaining fibrin is to whip freshly-shed blood with a bundle of twigs. The fibrin is then deposited on the twigs and may be easily washed; and if placed in a well-stoppered glass bottle and covered completely with glycerine it may be preserved for a considerable time.

The plasma of the blood, from which the corpuscles have been allowed to subside, if poured into another vessel, will coagulate in precisely the same manner as the original blood.

Coagulation is hindered or delayed by (*a*) addition of small quantities of alkalies and ammonia; (*b*) by concentrated solutions of neutral salts of the alkalies or alkaline earths; (*c*) by contact with the living tissues or blood-vessels; (*d*) by cold; (*e*) by the addition of large quantities of water.

Coagulation is accelerated by contact with foreign substances of all kinds, *e.g.* threads, twigs, and any substance which presents a number of points. In the case of lacerated wounds, the torn inner elastic coat of the arteries curls up, and by presenting a number of threads and points materially assists the coagulation of the blood, and thereby forming a clot which blocks the vessel and arrests the bleeding. As the result of a long series of researches by various physiologists it would appear that the coagulation of the blood results from the inter-action of three factors: fibrinogen, fibrinoplastin, and a ferment which has been called the fibrin ferment, and is supposed to be a product of the decomposition of the white corpuscles. The explanation of the phenomena is, however, very complicated and uncertain; the reader who desires further information of the subject should consult some of the larger and more recent text-books of physiology, *e.g.* Dr M. Foster, or Landois and Stirling.

The blood in the human body constitutes about 1-13th part of the total body-weight. The blood contains certain gases in solution, and more especially oxygen, which hold a peculiar relation to the hæmoglobin. These will be discussed under RESPIRATION.

The following report of a commission composed of MM. Mialhe, Mayel, Lefort, and Cornil, appointed to devise the best method for the examination of blood-stains, was published in 1873, The following translation of the report appeared in the 'Chemical News' of December 5th, 1873.

1st. When the stain is of recent date, or supposed to be so, the red corpuscles should be particularly examined, and every care taken to preserve them without change. The stains must not be washed with water, so that the hæmatin may not be altered. After insisting on the microscopic characters of the blood-stains, isolated or compared with those of various animals, the commission enumerates with care the fluids which are destructive or preservative of blood-corpuscles. Among the first, water, and particularly hot water, acetic, gallic, hydrochloric, and sulphuric acids; and of alkalies, potash and soda, even in weak solution, and ether and chloroform, also many other reagents, so alter the blood-corpuscles as to cause them to entirely disappear. Alcohol, chromic and picric acids, and bichromate of potash preserve the corpuscles, though they alter their form. The preservative fluids are those whose composition approaches nearest to serum, such as the iodised serum of Schultze, an excellent preparation made with amniotic fluid, to which are added a few drops of the tincture of iodine, so as to give it the colour of white wine; or, better, a fluid composed thus: white of egg, 30 grms.; distilled water, 270 grms.; and chloride of sodium, 40 grms.; or even a fluid containing 0·5% of chloride of sodium, or 5% or 6% of sulphate of sodium. If the stains be wetted and softened by these fluids, and then examined, white and red corpuscles and fibroid particles will be observed.

2nd. In more difficult cases, when the microscope, owing to the alterations which time has effect in the hæmatin, can give but vague information, examination by the spectroscope and chemical analysis enables us to arrive at precise results. The use of these means being less known, and also more delicate, requires special study.

1. *Spectrum Analysis.* Colouring matters have the power of absorbing certain coloured rays of white light—the same always for the same substance. This is the principle upon which spectroscopic examination is based. If into any analysing tube filled with water a few drops of solution of hæmoglobin be introduced, till it has the colour of peach-blossoms, the luminous rays of the spectrum passing through this fluid present two bands of absorption, in the lines D and E of Frauenhofer, in the yellow and the green. The same fact would be observed if a few drops of blood were substituted for hæmoglobin in the analysis.

In a case of doubt the hæmoglobin of the blood could be reduced by adding to this latter a reducing body. Destroyed hæmoglobin has a different spectrum from oxygenated hæmoglobin, a single absorption band as large as the two former bands united, and a little to the left of Frauenhofer's line D.

2. In blood in a state of decomposition, or which has been treated with acids or caustic alkalies, hæmoglobin is changed into a new substance; hæmatin is formed, which, combined with hydrochloric acid, gives definite crystals.

In order to obtain them we must proceed thus: A small fragment of dried blood is placed on a glass slide; it is dissolved in a drop of water, and

a minute portion of sea-salt added. It is covered with a thin slide, and pure acetic acid is made to pass between the two slides, and it is heated over a spirit-lamp to boiling-point; acetic acid is again added, and it is heated afresh; and this is repeated till the crystals are obtained.

They are rhomboidal, of a dirty brown colour, quite characteristic, and require to be seen with a magnifying power of three hundred or four hundred diameters. With the smallest quantity of blood these two reactions can always be produced —the spectrum examination and the crystals of hydrochlorate of hæmatin; and they are so certain that the existence of one alone enables one to affirm the presence of blood.

3. The third process, though not so exact as the preceding, ought, nevertheless, never to be neglected. If to a very small quantity of blood dissolved in a little water be added a few drops of tincture of guaiacum and of peroxide of hydrogen, a persistent blue colour is immediately produced; but this very sensitive reaction can be obtained with other organic matter, such as nasal mucus, saliva, &c.; it therefore only gives a probability. We must proceed in the following manner: A tincture of guaiacum is prepared with alcohol of 84% and guaiacum resin; a mixture of sulphuric ether and peroxide of hydrogen is also made, and enclosed in a stoppered bottle, and kept under water in the dark. This preparation is less liable to change than pure oxygenated waters. The object stained with blood, if it be white, is put into a little cup, then moistened with water to dissolve out the blood-stain, and washed in distilled water; this water is then submitted to the action of these reagents.

If the thing stained be coloured, and the stain little or not at all visible, it must be moistened, and then pressed between two or three sheets of white blotting-paper, and tried first with the guaiacum. If the stain be of blood, a reddish or brown spot will form on the paper.

One of the sheets should be treated with ammonia, and the stain will become crimson or green. A second sheet treated with tincture of guaiacum and ozonised ether will give a blue colour more or less intense, according to the quantity of the blood.

To recapitulate: 1. If the stains or scales of blood appear recent, the corpuscles may, after the necessary precautions, be examined under the microscope, and their presence, diameter, &c., observed, which will enable one to diagnose the origin of the blood, whether human or animal. 2. If the stains be old and the blood changed, the reaction with the tincture of guaiacum would make the presence of blood probable; but its actual presence cannot be affirmed without spectrum examination or the production of crystals of hydrochlorate of hæmatin; one of the two is sufficient. It is unnecessary to add that these reactions do not show whether the blood is human or animal.

Bullocks' blood has of late years, more especially in France, come into use as a remedy for anæmia and pulmonary phthisis. A correspondent, writing from Paris to the 'Medical Times and Gazette' in 1872, says: "It is a curious sight to see the number of patients of both sexes and of all ranks and ages, who flock to the slaughter-house every morning to drink of the still fuming blood of the oxen slaughtered for the table. I was struck with the facility with which young ladies take to it, and I have heard many say that they prefer it to cod-liver oil."

In a paper read in 1872 before the Academy of Sciences in Paris by M. Boussingault, detailing his researches into the composition of blood, the author expressed his surprise that bullocks' blood was not more generally used as a food, as it contains all the constituents of a perfect aliment. According to the above chemist, of all nutritive substances the blood of animals contains the largest amount of iron. In man, Boussingault found in 100 grms. of blood 51 milligrms. of iron; in that of the ox, 55 milligrms.; of the pig, 59 milligrms.; and in that of the frog, 42 milligrms. But it was not only in red blood that iron was found, Boussingault detected it in white blood also; and he found the blood of snails to contain as much iron as that of the ox or calf.

A simple and ingenious method for the therapeutic administration of the serum of the blood of sheep and oxen has been lately devised by Dr Francis Vacher, the medical officer of Birkenhead. Dr Vacher takes the blood of these animals, allows it to stand until it clots, removes the clot, and dries it at a gentle heat in a hot-air chamber. By this means he obtains a nearly odourless and comparatively tasteless powder, which is ten times the strength of fresh serum. To this preparation he gives the name '*serum sanguinis exsiccatum*.' He believes that his dried serum will prove a valuable nutrient in consumption, scrofula, diabetes, and loss of flesh.

Uses, &c. That of bullocks is employed for the clarification of wines and syrups; also in the preparation of adhesive cements, as the vehicle in coarse paint for outdoor work, as a manure, as a bleaching powder, to make pure animal charcoal, and for several other purposes. The blood of sheep, pigs, and bullocks, mixed with flour or oatmeal, and seasoned is eaten by the common people, but it is rather indigestible, and apt to induce disease. Gut-skins stuffed with this mixture form 'black puddings.'

Bullocks' blood, dried by exposure in thin layers to a current of air, at a heat under 125° F., and then reduced to powder, is exported in large quantities to the colonies, where it is used as a 'clarifier' in the sugar-works. Dried at a temperature ranging between 212°—220°, then coarsely powdered, and the dusty portion sifted off, it is much used by fraudulent dealers to adulterate grain-musk. See CHARCOAL (ANIMAL), GLOBULIN, HÆMATOSIN, PLASMA, SERUM, STAINS, VISION, &c.

Blood, Desiccated. SANGUIS BOVINUS EXSICCATUS. To prepare this substance blood is whipped to free it from fibrin, then evaporated at about 130° F., taking care not to coagulate albumen. The product is finally dried on sheets of glass to form scales.

Prop. It is freely soluble in cold water, on heating the solution albumen coagulates.

Uses, &c. Employed as a food in the form of enema. Also used by physiologists for experiments on the frog's heart.

Blood-purifying Tea, Gout and Rheumatic. (*Franz Wilhelm,* Neunkirchen.) Equal parts of senna leaves, sarsparilla root, liquorice, rad. tritici, red sandalwood, bittersweet stalks, cut small and mixed (*Hager*).

Blood-purifying Tea. (*F. Köller,* Graz.) Senna leaves, 32 parts; guaiacum wood, 10 parts, juniper wood, restharrow root, rad. tritici, dandelion root, chicory root, of each, 8 parts; alder bark, 3 parts; sassafras, 2 parts; star-anise, 5 parts, dirty and worm-eaten, roughly chopped, and mixed (*Hager*).

Blood, Spit′ting of. See HÆMOPTYSIS.

Blood, Vom′iting of. See BLEEDING, STOMACH DISEASES, &c.

BLOOD PLUM, of the Niger, the fruit of *Hæmatostaphis Barteri,* Hook, f.

BLOOD-ROOT, *Syn.* RED′-ROOT, PUCCOON′; SANGUINA″RIA, L. The *Sanguinār′ia Canaden′sis,* Linn., a papaveraceous plant of North America; also its root (SANGUINA″RIA, Ph. U. S.), which is the part used in medicine. Juice, blood-red, used in dyeing. In small doses (3 to 5 gr.) it is stimulant, diaphoretic, and expectorant: in large ones (10 to 20 gr.), narcotic, emetic, and purgative. The powder is sometimes used as an escharotic, the extract as an application for cancer. See SANGUINARINE.

BLOOD′STONE. A hard compact variety of hæmatite used to form burnishers. The name is also applied by lapidaries to the heliotrope.

BLOOM. In *perfumery,* &c., a name given to several calorific skin-cosmetics, of which the following are examples:

Bloom of Almonds (ah′-mŭndz). *Syn.* AL′-MOND-BLOOM. *Prop.* Boil 1 *oz.* of ground Brazil-wood in 2½ pints of soft water for 30 minutes, adding the juice of two lemons towards the end; strain, and add ⅜ *oz.* of isinglass, ¼ *oz.* of powdered cochineal, 1 *oz.* of alum, and ½ *oz.* of borax; boil again for 4 or 5 minutes, and strain through muslin. Glass or earthenware vessels must be used, as metals injure its colour.

Bloom of Roses. *Prep.* 1. Dried red rose leaves, 1½ *oz.;* boiling water, 1 pint; infuse in glass or earthenware for 2 hours, press out the liquor, and add the juice of 3 large lemons; the next day filter, or decant the clear portion. Both the above should be kept in a cool place, otherwise they soon spoil. A little spirit of wine (3 or 4 *fl. oz.* to the pint) is sometimes added to them to remove this objection. They are greatly inferior to the following:

2. Carmine, ¼ *oz.;* strong liquor of ammonia (not weaker than ·900), 1 *oz.;* put them into a stoppered bottle, set it in a cool place, and occasionally agitate it for two or three days, to effect a solution; then add of rose-water, 1 pint; and, after admixture, further add of esprit de rose, ½ *fl. oz.;* pure rectified spirit, 1 *fl. oz.;* again well agitate, and set the whole aside for a week; lastly, decant the clear portion from the dregs (if any) for use or sale. Very fine. A cheaper article is made by omitting a portion of the carmine, and the whole of the esprit and spirit; and a still inferior one by substituting 1½ *oz.* of silver-grain cochineal (in powder) for the carmine, with digestion for a week in the ammonia previously diluted with one half of the water.

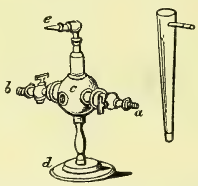
3. Pure carmine, ½ *oz.;* ess. white rose, 3 *fl. oz.;* sol. of potass. B.P., 6 *fl. dr.;* water, to make 20 *fl. oz.* Misce sec. art. Set aside for a few days, agitate occasionally, finally filter.

Bloom of Youth, or Liquid Pearl. (*G. W. Laird,* New York.) A colourless liquid holding in suspension 34% of zinc oxide entirely free from lead (*Chandler*).

BLOTE. To prepare or cure by drying and smoking; now only applied to fish.

BLO′TER. *Syn.* BLOAT′ER. A bloted fish; appr., a herring slightly salted, and only very slightly dried and smoked.

BLOWPIPE (blō′-). *Syn.* CHALUMEAU, Fr.; LÖTHROHR, Ger. (In this article there is included a short account of Blowpipe Analysis.) An instrument by means of which a jet of air is directed into the centre of the flame of a candle, lamp, or gas-jet; the combustion is thus much more complete than in the case of an ordinary flame, and the temperature attained is therefore much higher. The mouth blowpipe (see fig. 2)



1. Hemming's safety-jet for the oxy-hydrogen blowpipe.
a, Pipe conveying oxygen gas.
b, „ „ hydrogen gas.
c, Ball stuffed with fine wire-gauze.
e, Jet (internal diameter 1-80th of an inch).
2. Black's blowpipe.

consists of a cylindrical or slightly conical tube, at one end of which is a mouthpiece, and at the other a jet with a fine orifice, fixed at right angles to the main tube. The tip of this jet is inserted into the flame, and a gentle and continuous current of air is blown through it. A brush of flame is thus obtained consisting of two cones: (1) an inner blue cone—the DEOXIDISING or REDUCING flame, so called because many substances when placed in it are deprived of the oxygen which they contain; (2) an outer yellowish cone—the OXIDISING flame; oxygen is here present in excess, and the temperature is very high, consequently many substances are made to combine with oxygen when placed in this part of the flame.

Some practice is required in the use of the blowpipe, as a continuous current of air has to be kept up while at the same respiration is going on. To effect this the mouth is filled with air and the cheeks distended, the air being forced through the blowpipe simply by the pressure of the muscles of the cheeks. During an inspiration the tip of the tongue is placed against the roof of the mouth, thus acting as a valve, and closing the cavity of the mouth while air is inspired through the nostrils; at the same time the cheek-muscles are still forcing air out of the mouth. As the mouth gets empty, it is replenished from the lungs by momentarily withdrawing the tongue from the roof of the mouth. The method is

somewhat difficult to describe, and can only be learnt by practice. It will be found easier to try first of all with an ordinary wash-bottle provided with a fine jet till a continuous stream of water can be maintained from the jet; when this can be done, no difficulty will be experienced in the use of the blowpipe itself.

Substances to be submitted to the action of the blowpipe flame are placed on a loop of platinum wire, in a small platinum spoon, or in a small hollow scraped in a piece of charcoal. Pine-wood charcoal is best, and the sides, not the ends, of the fibres should be presented to the flame. Only small quantities of substances can be operated on with a mouth-blowpipe.

The following are the chief reactions that can be observed by means of the blowpipe. FLAME-COLOURATIONS. The substance to be examined is placed on a loop of platinum wire moistened with hydrochloric acid, and held in the flame. The flame is coloured by salts of SODIUM, yellow; of POTASSIUM, violet; of CALCIUM, red; of STRONTIUM, crimson; of BARIUM, green. If sodium is also present, the violet colouration due to potassium is obscured, but may be seen by looking at the flame through a piece of blue glass.

REDUCTIONS. Compounds of the following metals yield metallic beads when heated with sodium bicarbonate on charcoal in the reducing flame of the blowpipe; SILVER and LEAD give malleable beads, BISMUTH and ANTIMONY give brittle ones.

Compounds of the following two metals are not reduced when treated as above, but, when heated with a mixture of potassium cyanide and sodium bicarbonate in the reducing flame, compounds of TIN give a white bead, and those of COPPER a red bead.

Compounds of MERCURY and ARSENIC, when heated on charcoal with deoxidising agents, are reduced to the corresponding metals, but these at once volatilise (arsenic may be detected by its garlic-like odour).

Compounds of IRON, NICKEL, and COBALT, when heated on charcoal with reducing agents, are reduced to magnetic metallic powders, which are attracted by a magnetised knife-blade.

Compounds of CADMIUM and ZINC, when heated on charcoal with reducing agents, are reduced to metal, but immediately oxidise, forming an incrustation of oxide on the charcoal. Cadmium oxide is a characteristic brown, and zinc oxide yellow when hot and white after cooling.

BORAX BEADS. A small loop of platinum wire is heated in the flame, and then dipped into some powdered borax; some of this adheres to the wire, and is heated in the flame till it forms a glassy bead in the loop. This bead is touched against some of the substance to be examined; a little of the latter thus adheres and is fused till it is incorporated into the bead, to which in many cases it imparts a characteristic colour.

An IRON bead is pale yellow in the oxidising, and pale green in the reducing flame.

A COBALT bead is deep blue in either oxidising or reducing flame.

A NICKEL bead in the oxidising flame is reddish-yellow while hot, and becomes nearly colourless on cooling; in the reducing flame it is grey.

A MANGANESE bead is amethyst-coloured in the oxidising flame, colourless in the reducing flame.

A CHROMIUM bead is green in either oxidising or reducing flame.

A COPPER bead is greenish-blue in the oxidising flame, colourless in the reducing flame. Among other tests may be mentioned the following:

Compounds of MANGANESE, when fused on a platinum wire with bicarbonate of soda in the oxidising flame, give a bright *green* bead.

Compounds of CHROMIUM, heated on platinum foil in the oxidising flame with sodium carbonate and repeated small additions of potassium nitrate, yield a *yellow* mass which gives a yellow solution in water.

Compounds containing SILICA, when fused with the bead obtained by heating microcosmic salt on a platinum wire, give a bead which is not transparent, but is encrusted with an insoluble coating of silica.

Compounds of certain metals, when heated on charcoal in the oxidising flame, and then moistened with solution of cobalt nitrate or chloride, and again heated, give coloured residues, thus:

ZINC compounds give a *green*,
ALUMINIUM compounds a *blue*, and
MAGNESIUM compounds a *pink* residue.

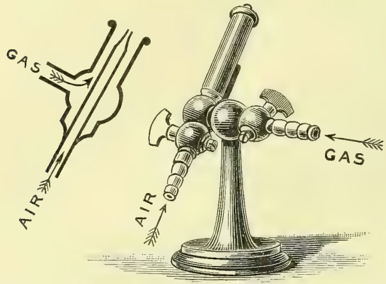
Many of these reductions may be carried out by means of a *Bunsen* burner, with the supply of air so regulated as to produce both oxidising and reducing flames. When the compounds of certain metals are heated on an asbestos fibre in the reducing flame and a porcelain basin containing cold water is held just over them, the metals produced by deoxidation are volatilised, and condense in a film on the cold surface of the basin. ANTIMONY, ARSENIC, BISMUTH, MERCURY, CADMIUM, ZINC, and LEAD give films in this manner; a further examination of the film frequently enables one to distinguish the metal of which it is composed.

Another method of effecting reductions is to fuse a crystal of sodium carbonate on the end of a match, so that the latter is covered with the fused salt; the whole is then heated in the flame till the match is converted into a rod of charcoal. Some of the substance to be examined is now placed on the end of this and heated in the reducing flame. When the reduction is complete, the end of the charcoal splinter is examined with a lens, or it is crushed in an agate mortar, the charcoal washed away with water, and the metallic residue examined.

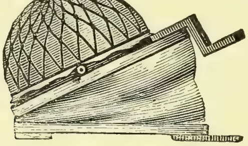
Blowpipe Analysis. See BLOWPIPE.

Blowpipe, Herapath. A large blowpipe employed to produce a flame of sufficient dimensions to be used in working glass tubes and making glass apparatus. Many varieties are constructed, but they are all fundamentally similar. They consist of an outer tube along which coal-gas flows (see fig. next page), and inside this a smaller concentric tube with a moderately fine nozzle, through which a jet of air is forced into the flame formed by lighting the gas as it issues from the mouth of the larger tube. The apparatus is mounted on a heavy foot, and is capable of adjustment so that the blast may be turned in any required direction; connections are made with india-rubber tubes to the gas supply, and to the reservoir of compressed

air, which is usually a pair of bellows worked by



the foot, and having a sheet of india-rubber tied on to the top (see fig.); the air is forced under



this from the bellows and causes it to distend, thus forming an elastic bladder which exercises a continuous pressure on the air inside, and expels it in a steady stream from the nozzle of the blowpipe.

Blowpipe, Oxyhydrogen. A blowpipe in which a mixture of oxygen and hydrogen, or more commonly of oxygen and coal-gas, is burned. The mixed gases are passed through a tube packed with wire-gauze before reaching the jet; in case the flame should run back, it is thus cooled by passing through the gauze, and does not cause an explosion of the mixed gases in the reservoir. Now, however, that oxygen can be so easily procured in iron bottles under pressure, it is customary to use an ordinary blowpipe and simply connect the air-jet to the reservoir of compressed oxygen. The oxyhydrogen flame has a very high temperature, which is exceeded only by that of the electric arc; it is used in melting platinum and in fusing together the edges of platinum plates in what is termed 'autogenous soldering.' Before the introduction of the electric light, the oxyhydrogen jet was much used to render a cylinder of lime incandescent, this being the well-known 'Drummond lime-light,' which, next to the electric, is the most brilliant artificial light known.

BLUB'BER. *Syn.* AD'EPS BALÆNA"RUM, L.; GRAISSE DE BALEINE, Fr. The soft fat of whales, and of other large sea-animals, from which the oil (TRAIN'-OIL, WHALE'-OIL) is obtained by heat.

Blubber, Sea. The popular name of several species of marine animals of the genus *Medusa*, having a body resembling a large mass of jelly. They are very plentiful in some parts of the coast of England, and are said to form a rich and cheap manure for pasture and arable land. They are used at the rate of about 1 ton to every 20 or 30 loads of mould, together with a chaldron of lime, per acre. In 3 or 4 months the land is usually found in prime condition. Pilchards, and other fish that swarm upon our coasts, and for which there is not a ready market, may be used in the same way, and are much richer, being, when properly managed, but little inferior to guano.

BLUE DYE. *Syn.* TEINTE BLEUE, Fr.; BLAU FARBE, Ger.

Indigo Dyeing. The colouring matter of indigo is one of the most permanent to light and air with which we are acquainted. Its use depends upon a principle different from that usually followed in dyeing, and consists in reducing the indigo by means of some deoxidising agent to a colourless soluble compound which, on exposure to air, becomes reoxidised, yielding thereby insoluble indigo. The goods to be dyed are dipped into a solution of the colourless compound, and then exposed to the air, when they acquire a blue colour. For cotton dyeing, chemical reducing agents such as ferrous sulphate, zinc dust, and hyposulphite of soda are used, since the dyeing can be effected in the cold by these agents, and the vat is under better control than in the fermentation methods. For wool, the indigo is usually reduced by means of reducing agents resulting from fermentation carried on at a moderate temperature.

Application to Cotton. Ferrous sulphate Vat. The indigo is first ground with water to a fine powder. The vat is then made up in the following proportions:

	For Cloth.	For Yarn.
Water	4000 litres . .	750 litres.
Indigo	40 kilos. . .	4 kilos.
Ferrous sulphate .	60– 80 „ . .	6– 8 „
Slaked lime (dry) .	50–100 „ . .	5–10 „

Here the following reactions occur: The lime reacts with the ferrous sulphate, producing ferrous hydrate, which in its turn reduces indigo, being itself converted into ferric hydrate, the reduced indigo then combining with the excess of lime, producing a soluble compound (indigo-white). The vats are usually rectangular vessels of wood, stone, or cast-iron. They are first filled with water, the ground indigo and lime are then added and well stirred up, and, lastly, the ferrous sulphate is dissolved and poured in. The contents of the vat, after mixing, are thoroughly stirred at intervals during twenty-four hours. The ferrous sulphate should be as pure as possible. Copper sulphate, by its oxidising action, would counteract the effect of the ferrous sulphate, whilst aluminium and ferric sulphates would be precipitated by the lime, thereby increasing the sediment and necessitating a larger expenditure of the latter substance. A freshly made-up vat should show numerous dark-blue streaks when stirred, and its surface should become rapidly covered with a blue scum or 'flurry.' The liquid should be clear and of a brownish-amber colour. If greenish, the whole of the indigo is not reduced, and in that event more ferrous sulphate should be added. If very dark in colour, more lime must be added.

Cotton yarn should be well boiled in water before dyeing, so that the dye may deposit evenly. The vats are usually worked in sets of ten, especially if dark shades are required, the cotton being first introduced into a nearly exhausted vat, wrung out, set aside to oxidise, and then transferred to the next somewhat stronger vat, and so on through the whole series. If light shades are being produced, a smaller number of vats

will suffice. Before dyeing, the 'flurry' should be skimmed off. At the end of the day the contents of the vats are well stirred up, and replenished with small quantities of lime or ferrous sulphate, according to their appearance. After dyeing, the goods are passed through dilute sulphuric acid of 2°—4° Tw. (1·01 to 1·02 sp. gr.), to remove carbonate of lime. They are then immersed in a strong lye bath, wrung out, and dried at 60° C. This last treatment gives a bronze tint to the goods.

Application to Wool. Woad Vat. The following vat is the one most generally used for dyeing wool:

It is prepared in a cylindrical vessel, 2 metres wide and 2 metres deep, the upper part being surrounded by a steam jacket, so that the contents may be maintained at a temperature of 45°—50° C. In order to prevent the stirring up of the sediment as much as possible, a frame carrying a rope network is suspended at about the middle of the vat. The latter is first filled with water, 300 kilos. of crushed woad are then added, and the mixture is heated to 50°—60° C. for 24 hours, with frequent stirring; 15 kilos. of well-ground indigo, 10 kilos. of bran, 2 to 15 kilos. of madder, and 6 kilos. of dry slaked lime, are now added, and the whole well stirred up and left to itself for 12 to 24 hours. By this time the fermentation should be in full progress. The surface of the liquid should be covered with 'flurry,' the liquid should have a greenish-yellow colour, interspersed with streaks of regenerated indigo, and a piece of cloth immersed in it should be dyed blue after exposure to the air. The odour of the vat should be agreeable, and the sediment, when brought to the surface, should have a slightly sour smell. It is now only necessary to keep the liquid at a temperature of 45°—50° C. (113°—122° F.) for another 24 hours, and to add another 6 kilos. of lime during the interval, the mass being well stirred up after each addition. The wool, before dyeing, must be boiled in water, well rinsed in tepid water, especially if it has been milled with soap, squeezed, and then passed at once into the vat. It should not be allowed to lie in heaps before dyeing, otherwise the colour will be irregular. The wool is moved about for a sufficient time (from 20 minutes to 2 hours), care being taken that it is always kept below the surface. It is then squeezed, thrown into heaps to allow the colour to develope, passed through weak acid to remove carbonate of lime, washed, and dried. Woollen cloth, after dyeing, is well milled with soap and fuller's earth, to remove loosely adhering indigo. The management of fermentation-vats is somewhat difficult in practice and requires experience. The most common derangement is a too active fermentation, due to a deficiency of lime, whereby the indigo may be entirely destroyed. This may be recognised by the 'flurry' disappearing, and by the development of a muddy liquid of a dirty yellow colour and very disagreeable odour, which has the property of destroying the blue colour of a piece of previously dyed cloth. The only remedy is to heat the vat to 90° C., and add more lime. Another difficulty is caused by dyeing too rapidly. In this case the indigo becomes precipitated owing to the large amount of oxygen introduced, and the colours produced are pale. The remedy is to add more lime, and then after a time to promote fermentation by the addition of woad and by warming. If too much lime is added, the indigo-white may be entirely precipitated. This may be remedied by the cautious addition of dilute sulphuric acid. When working normally the vat is replenished by the addition, at the end of each day, of fresh quantities of lime and bran, and at the end of every other day of 5 to 8 kilos. of indigo.

Urine Vat. This vat is suitable for indigo-dyeing on a small scale. It is made up as follows: Add to 500 litres of stale urine 3 to 4 kilos. of common salt, and heat to 50°—60° C. (122°—140° F.) for 4 to 5 hours, with frequent stirring; then add 1 kilo. of madder and 1 kilo. of ground indigo, stir well, and allow to ferment until the indigo is reduced.

Logwood Blues. Application to Cotton. These are now seldom employed on account of their fugitive nature.

Application to Wool. These are much used to imitate the blues of the indigo vat. They are also combined with indigo-blues, the fabric being first dyed to a light shade with indigo, and then afterwards with logwood. The method is as follows:

Mordant the wool with 4% of aluminium sulphate and 4% to 5% of cream of tartar for 1 to $1\frac{1}{2}$ hours at 100° C. Wash well and dye in a bath containing 15% to 30% of logwood and 2% to 3% of chalk for 1 to $1\frac{1}{2}$ hours, at a temperature of 100° C. The chalk may be replaced with advantage by calcium acetate to the extent of 30% of the weight of the wool. With increased quantities of alum and tartar, a redder shade is obtained. The colours produced by alum are not very fast, and may be improved by adding 0·5% to 3% of bichromate of potash to the mordanting bath. Or the mordant may consist of 3% of bichromate of potash, and 1% of sulphuric acid (168° Tw., or 1·840 sp. gr.) only. A purplish bloom, resembling that of indigo, may be imparted by adding 0·5% to 1% of tin crystals ($SnCl_2,2H_2O$) towards the end of the dyeing.

Aniline Colours. Spirit Blue. Methyl and Ethyl Blues. These colours are derivatives of diphenylamine blue:

$$C\begin{cases} C_6H_4.NH(C_6H_5) \\ C_6H_4.NH(C_6H_5) \\ C_6H_4 \\ NH.C_6H_5Cl. \end{cases}$$

They are characterised by the pure greenish-blue colour which they yield. They should be dissolved in 40 to 50 times their weight of methylated spirit, with the addition of a little sulphuric acid.

Application to Cotton. Work the cotton in a soap-bath, containing 60 to 100 grms. of soap per kilo. of cotton, at 60° C. (140° F.), squeeze, and work in a cold bath of aluminium acetate of 8° Tw. (1·04 sp. gr.), and squeeze again. Repeat this three times, and then transfer to the dye-bath. The colour is added to the latter, little by little, the temperature being gradually raised to boiling.

Application to Wool. Enter the wool at 50°—

60° C. (122°—140° F.) and add gradually a mixture of 1% to 5% of colouring matter, 4% to 8% of sulphuric acid of 168° Tw. (1·84 sp. gr.), and 10% to 20% of sodium sulphate, the bath being at the same time rapidly heated to 100° C. and boiled for half an hour. Spirit blues are apt to dye unevenly owing to their insolubility, but they are preferred by yarn dyers.

Application to Silk. The silk is introduced into a bath, containing boiled-off liquor (see SILK) acidulated with sulphuric acid, at 50°—60° C. (122°—140° F.). The dye is added gradually, and the temperature slowly raised to boiling.

Soluble Blues. These are sodium or ammonium salts of di- and tri-sulphonic acids of rosaniline- or diphenylamine blues. The redder shades are known as serge blue, navy blue, blackley blue, &c., whilst the purer tones are named china blue, night blue, soluble blue, water blue, cotton blue, &c.

Application to Cotton. Work the cotton at 60° C. (140° F.) in a bath containing a sufficient amount of the colour solution and 3% stannate of soda. When the cotton is saturated, acidify with sulphuric acid and work for another half hour.

Application to Wool and Silk. The same method is used here as for spirit blues.

Alkali Blue. This is a monosulphonic acid of rosaniline blue, and is known as Guernsey blue, fast blue, Nicholson's blue, &c. Blue and red shades are sold. Alkali blue cannot be used for cotton. In wool-dyeing the material is always introduced into an alkaline solution of the dye, a colourless sodium salt being then formed. The colour is afterwards developed by immersion in an acid bath.

Method. Add to the dye-bath 0·5% to 5% of the colour solution, according to the shade required, and 4% to 8% of carbonate of soda (crystals). The water used for the dye-bath should be free from lime salts. Introduce the wool at 40° C. (104° F.), heat rapidly to 100° C., and boil for ½ to ¾ hour. Then remove, wash well in water and introduce into a bath containing 5% of sulphuric acid of 168° Tw. (1·84 sp. gr.). Work for 15 to 20 minutes at 60° C., by which time the colour should be developed, and then wash well with water. The wool should only have a very faint blue colour after removal from the first bath. Care must be taken not to add too much alkali, otherwise the colour may be inferior. Some samples of dye contain in themselves a sufficient amount of alkali. The dye-bath is never exhausted in one dyeing and should be used again, small additions of dye and alkali being made. Faster colours may be obtained by adding zinc sulphate or alum to the acid. Alkali blues are well adapted for dyeing with acid colours (see DYEING) such as croceïn scarlet or orange. In this case a bath of the acid dye takes the place of the sulphuric acid bath.

Alizarin Blue. (For chemistry and properties see ALIZARIN.)

Application to Cotton. Mordant the cotton with an alkaline solution of a chromium salt (see MORDANTS); dye in a separate bath with alizarin blue S (if the insoluble variety XR is used, some bi-sulphate of potash must be added to dissolve it), raise the temperature to boiling in the course of 1½ hours, and boil for half an hour.

Application to Wool. Mordant with bichromate of potash (the amount of the latter being 3% of the weight of the wool) and sulphuric acid, using not more than 1% of the latter (of 168° Tw. or 1·84 sp. gr.). Dye in a separate bath, raising the temperature gradually to boiling, and continuing the ebullition until a bright shade is obtained. With continued boiling the dye enters the fibre instead of being only superficially attached. The colour has a purplish bloom and resembles indigo. It is very fast to light, and to scouring, &c.

Mineral Blues. Prussian Blue. Application to Cotton. Work the cotton in a solution of ferrous sulphate, squeeze, and introduce it into a solution of sodium carbonate, when ferrous hydrate will be precipitated. Then expose to the air or pass through a weak solution of bleaching powder, which will oxidise the ferrous to ferric hydrate. Wash the cotton and introduce it into a cold solution of 20 grms. of potassic ferrocyanide and 10 grms. of sulphuric acid of 168° Tw. (1·84 sp. gr.) per litre, wash, and dry. The intensity of the colour will depend upon the amount of ferric oxide fixed upon the fabric. Purplish shades may be obtained by working the cotton at 30° C. (86° F.) in nitro-sulphate of iron at 5° Tw. (1·025 sp. gr.), to which 2% to 3% of stannous chloride has been added, and then dyeing in the above ferrocyanide solution. Prussian blue has not been much employed since the introduction of aniline blues.

Application to Wool. In this case the ferrocyanide of potash is simply decomposed by an acid; the liberated hydro-ferrocyanic acid is then absorbed by the wool, and gradually undergoes decomposition with the production of Prussian blue.

Method. Introduce the wool into a cold bath containing 10% of potassium ferricyanide (red prussiate of potash) and 26% of sulphuric acid of 168° Tw. (1·84 sp. gr.), raise the temperature to boiling in the course of an hour, and boil for ½ to ¾ hour. Sometimes a mixture of sulphuric, nitric, and hydrochloric acids is employed instead of the first only. The following is the composition of the 'blue spirits' used by dyers for the production of Prussian blue on wool: 4 measures of sulphuric acid of 168° Tw. (1·84 sp. gr.), 2 measures of hydrochloric acid of 32° Tw. (1·16 sp. gr.), and 1 to 2 measures of nitric acid of 64° Tw. (1·32 sp. gr.). Prussian blue on wool is sometimes known as royal blue.

BLUE GUM TREE. See EUCALYPTUS.

BLUE, Liquid, is made from the finest Chinese blue, ½ oz., and oxalic acid, ¼ oz. to the pint of water.

BLUSH'ING. *Syn.* RU'BOR, RUBE'DO, L. In *physiology*, &c., the red glow on the cheeks or face occasioned by confusion, bashfulness, surprise, or shame.

Blushing is caused by a sudden increase in the quantity of the blood in the capillaries; and, consequently, a heightening of the natural pale-reddish hue of the skin. It is referable to sudden mental emotions of an exciting character, such as surprise, confusion, consciousness of slight, injury, or indignity, and the like. Emotions of a depressing character frequently produce an oppo-

site effect. This is termed pallor, and depends on a diminution of the blood supply to the skin and surface of the body. The first, though often unpleasant, is never dangerous; the last may be so in some cases. The cure of the habit of blushing consists in persisting efforts to maintain a sufficient degree of presence of mind and self-confidence to permit of reflection, or a calm view of the exciting circumstance, instead of sinking into a state of temporary mental imbecility and helpless confusion.

The cause of blushing is nervous, and depends upon the action of the nervous system upon the walls of the capillaries, causing their muscular coats to relax and consequently increasing their diameter; pallor, conversely, is caused by contraction of the muscular coats of the vessels and consequent diminution of their calibre; sudden and excessive pallor occurs in fainting, and by reason of the increased flow of blood to the internal organs causes increase of pressure upon the already feeble heart; anything, therefore, such as flipping with a wet towel, hot cloths and the like, which tend to promote redness, *i. e.* flow of blood to the skin, is useful, inasmuch as the pressure on the heart is thereby to some extent relieved.

BOARDS, to make White. Boards may be rendered white and clean by scrubbing them, instead of with soap, with a mixture composed of one part of freshly-slaked lime and three parts of white sand.

BOARDS, MILL-. Used for book backs, &c., should be made of old manila hawsers, moulded in the same way as hand-made paper and well rolled between steel rollers.

BOCKBIERESSENZ, for the artificial imitation of bockbier. A tincture of 1 part lupulin, 2 parts pyroligneous acid, and 8 parts spirits of wine (*Hager*).

BOER TEA. The leaves of *Cyclopia Vogelii;* the leaves of two other species of *Cyclopia* are also used in S. Africa as tea, viz. *C. genistoides* (Honig Thee) and *C. latifolia* (Bush tea); also the leaves of *Borbonia parviflora* (Stekel Thee).

BOG SPAVIN. In horses, a distension of the bursa or sheath of the true hock-joint. Mr Finlay Dun prescribes rest; high-heeled shoe, fomentation, cold water, spring truss, counter-irritation, firing-iron; seton.

BOIL (boyl). *Syn.* FURUN'CULUS, L.; FURONCLE, Fr.; BEULE, EITERSTOCK, Ger. In *surgery*, a well-known inflammatory tumour, of a superficial and more or less temporary character, which generally terminates by suppuration.

Boils (*furun'culi*) generally attack the healthy and robust during the period of youth and early manhood, and seldom trouble persons who have arrived at the middle age of life.

Treatm., &c. When boils begin to appear, and exhibit persistency by daily enlargement and increasing pain, suppuration should be promoted by warm poultices of bread and linseed-meal, to which a little fat or oil may be added, to prevent their getting hard. If poultices are inconvenient, warm and stimulating embrocations, or exposure to the vapour of hot water, or the application of stimulating plasters may be adopted instead. When the tumour is sufficiently 'ripe,' the matter should be evacuated by gentle pressure, and the wound dressed with a little simple ointment spread on a piece of clean lint or linen. The diet may be full and liberal until the maturation of the tumour and the discharge of the matter, when it should be lessened, and the bowels kept gently open by saline purgatives, as Epsom salt or cream of tartar. When there is a disposition in the constitution to the formation of boils, the bowels should be kept at all times regular, and tonics, as bark or steel, had recourse to, with the frequent use of sea-bathing when possible. A course of sarsaparilla may be likewise taken with advantage. See ABSCESS, TUMOURS, &c.

Dr Sydney Ringer prescribes a 1-16th grain of sulphide of sodium mixed with sugar of milk three or four times a day on the tongue; but this should only be administered under medical supervision.

Treatment for HORSES and CATTLE. Fomentations; poultices containing belladonna, cold water, carbolic acid dressing, counter-irritants, laxatives, sulphites, and chlorates.

BOIL'ERS. See INCRUSTATION and STEAM.

BOIL'ING. In *cookery*, the operation of dressing food in water at the point of ebullition, or one very closely approaching it. The practice of cooking animal food by boiling, although exceedingly simple and often most convenient, is neither judicious nor economical when the broth or liquid in which it has been dressed is to be rejected as waste; as in this way the most nutritious portion of the flesh of animals, consisting of soluble saline and other matter required for the formation of bone and the nutrition of the muscular tissues, &c., is to a great extent lost. This particularly applies to small pieces so dressed, and to those presenting a large surface to the action of the water in proportion to their weight. Large pieces of meat suffer less in proportion than smaller ones, for the same reason; but even with them the outside should be rejected, as it is both insipid and innutritious compared with the interior portion. To reduce the solvent and deteriorating action of the water to the lowest possible point, the articles to be boiled should not be put into the water until it is in a state of full ebullition, which should be maintained for 5 or 6 minutes afterwards, by which time the surface and the parts lying immediately beneath it will have become, to a certain degree, hardened, and will then act as a protective shield to the inner portion of the mass. The boiling being continued for 5 or 6 minutes cold water is added, until the temperature becomes about 150° F., and the cooking of the joint is carried on at this heat until the meat is done. Meat loses nearly a fourth of its weight in boiling; salt meat, which is intended to be eaten cold, should be allowed to cool in the water in which it has been boiled. The practice of dressing meat by putting it into cold water, which is then gradually raised to the boiling-point, cannot be too much censured. A ¼ of an hour per lb. for dressing young meat, poultry, and small pieces, and 20 minutes per lb. for old, tough, and larger ones are the usual times allowed by cooks for the purpose. See BOUILLI, FOOD, &c.

BOIL'ING-POINT. See EBULLITION

BOIS DURCE (bwah dŭr-sā). [Fr.] The substance invented in France, and to which this name is given, is made from sawdust, which, under the influence of a high temperature and the enormous pressure of 600 tons, acquires a degree of hardness very much exceeding that of ordinary wood. It has a very fine grain, and is unaffected by atmospherical variations; but its principal merit is its adaptation to moulding, so that by the most economical processes forms and impressions are given to it which it would require, in any other way, considerable labour and workmanship.

BOLAS. Sweet light cakes which, according to Mrs Rundell, are prepared as follows: Into flour, 2 lbs., pour of warm milk ¾ pint, a small teacupful of yeast, and 6 eggs; make a dough, add of butter 1 lb. (by degrees), and set it in a warm place to rise for an hour; then mix in of powdered sugar 1 lb., and make the mass into cakes. Put these into cups or tins previously well buttered, and ornament the top with candied orange or lemon peel; lastly, bake them. See CAKES.

BOLDO (Nat. Ord., MONIMIACEÆ). A shrub, *Peumus fragrans* growing in the Chilian Andes. It contains Boldina, a glucoside, having hypnotic properties. The bark is used in tanning, and the wood makes a good charcoal. It is reported to be useful in affections of the liver and digestive organs. It has been employed as a tonic in cases where quinine is inadmissible. In large doses it provokes vomiting. The powder of the dried leaves is a sternutatory. See a paper by M. Claude Verne, translated into the 'Pharm. Journ.,' 3rd series, v, 405.

Tincture of Boldo. Boldo leaves 1 oz., proof spirit 10 oz.—*Dose,* 10 to 20 minims.

BOLE. *Syn.* BO′LUS, L.; TERRE BOLAIRE, &c., Fr. The name of several argillaceous minerals, varying in colour from white to yellow, red, and brown, which they owe chiefly to iron. See OCHRES and RED and BROWN PIGMENTS.

BOLOGNA″ PHI′AL (-lawn′-yă). See PHIALS

BO′LUS. [L., Eng.] *Syn.* BOL, Fr. Boluses, in *pharmacy* and *medicine,* are small, roundish masses of medicinal substances, which are taken in the same manner as pills, which they resemble, except in their larger size. Those persons who object to swallowing them in their common state may wrap them in soft paper, or introduce them into the emptied husks of raisins or grapes.

Boluses (bo′lī, L.) are prepared with the same ingredients, and in a similar manner to pills (which *see*).

Bolus, Guaiacum. (*Horne.*) Guaiacum resin ½ dr., elder rob, enough to make into a bolus. Formerly given in quinsy.

Bolus for Ague. (The *bolus ad quartanum* of the French Hospital.) Peruvian bark, 1 oz.; carbonate of potash, 1 dr.; tartarised antimony, 15 gr.; syrup, a sufficient quantity. One to be taken every four hours during the intermission.

Bolus, Vermifuge (*Dr Campbell*). Basilic powder, 1 scruple; conserve of wormwood, a sufficient quantity to make into one bolus for an adult (*Foy*). Powdered pomegranate root 1 dr., assafœtida ½ dr., croton oil 3 or 4 drops, syrup sufficient. Divide into 15 boluses; 5 daily for tapeworm (*French Hospital*). Wormseed 1 scruple, calomel 5 gr., camphor 15 gr., syrup sufficient. Make into 3 doses; one, two, or three in the day.

BOMAH NUT. The fruit of *Pycnocoma macrophylla,* a native of Natal. Used for tanning purposes.

BONACE, or **BURN-NOSE.** *Daphnopsis tinifolia,* a tree of Jamaica, the inner bark of which is very fibrous, and is used for ropes, cordage, &c.

BON′-BON (bōng-bōng). [Fr.] A sugar-plum. See CONFECTIONERY and SUGAR-PLUMS.

BONBONS VERMIFUGES OF GAROZ. A bonbon containing 15 centigrms. of scammony, and 2 centigrms. of santonin (*Reveil*).

BONDUC SEEDS. Are produced by the *Cæsalpinia bonducella.* They are also called nicker beans. In India the powder is used as a tonic and anti-periodic.—*Dose,* 5 to 15 gr.

BONE. *Syn.* OS, L., Fr.; BEIN, KNOCHEN, Ger.; BÁN, Sax. The hard substance forming the interior skeleton of animals, or any single part of it.

Comp. According to Berzelius:

	Human bones.	Ox bones.
Animal matter soluble in boiling water	32·17	33·30
Vascular substance	1·13	
Phosphate of calcium, with a little fluoride of calcium	53·04	57·35
Carbonate of calcium	11·30	3·85
Phosphate of magnesium	1·16	2·05
Chloride of sodium and other salts	1·20	3·45
	100·	100·

The soluble animal matter is chiefly fat and gelatin.

Uses, &c. The bones of animals are employed for various purposes in the arts, manufactures, and domestic economy. Those of good meat form most excellent materials for making soups and gravies, as is well known to every cook. In France, soup is extensively made by subjecting bruised bones to a steam heat of 2 or 3 days' continuance. In England the same is commonly effected in an iron Papin's digester. When the earthy matter of a bone is dissolved out by digesting it in a large quantity of very dilute hydrochloric acid, a lump of gelatine is obtained, which, after being well washed with water, is equal to isinglass for all the purposes of making soups and jellies. The following is the process recommended by Proust for making the best of bones, in hospitals, gaols, and similar establishments:

The bones, crushed small, are to be boiled for 15 minutes in a kettle of water, and the fat (which is fit for all common purposes) skimmed off as soon as cold. The bones are then to be ground, and boiled in 8 to 10 times their weight of water (of which that already used must form a part), until half of it is wasted, when a stiff jelly will be obtained. Iron vessels should alone be used in this process, as the jelly and soup act upon copper, brass, and the other common metals. The bones

of fresh meat are the most productive; those of boiled meat come next, whilst those of roasted meat scarcely afford any jelly. As 'boning' meat before cooking is now a very general practice, a quantity of fresh bones may always be obtained.

Bones are, for the most part, WROUGHT, TURNED, BLEACHED, and DYED in a similar manner to ivory, but with less care, owing to their inexpensive and coarser character. Before being submitted to any of these operations they are, however, first submitted to long boiling, to deprive them of grease.

The bones of living animals may be dyed by mixing madder with their food. The bones of young pigeons may thus be tinged of a rose colour in 24 hours, and of a deep scarlet in 3 days; but the bones of adult animals take a fortnight to acquire even a rose colour. In the same way extract of logwood tinges the bones of young pigeons purple. See BLEACHING, DYEING, IVORY, &c.

In all manufacturing processes in which bones are operated upon, foul vapours, unless special precautions are observed, will be thrown off, to the great annoyance and discomfort of those living near the building where the operations are performed.

To avoid this the offensive vapours should always be carried by a flue made for the purpose into the furnace-fire, and there consumed. But this will not remedy another source of annoyance which arises from the disgusting stench caused by the putrefaction of the flesh adhering to the bones, which lie in heaps about the premises.

The trade of a bone-boiler comes under the head of offensive trades (see 'Public Health Acts,' s. 112-114), and is under the control and regulation of an urban sanitary authority, which has also the power of preventing the bone-boiling being carried on within its district if it thinks proper.

BONE′-ASH. Impure triphosphate of calcium, obtained by calcining bones to whiteness, and reducing the ash to fine powder. Used to make pure phosphate of calcium, to form cupels, &c.; also sold for burnt hartshorn.

BONE′-DUST. *Syn.* BONE-MANURE. Bones (previously boiled for their grease) ground to different degrees of coarseness in a mill. It is sown along with the seed in a drill. Wheat thus treated is said to yield 30% to 50% more weight in straw and grain than by the common methods. Turnip and other light soils it renders more than ordinarily productive. Bone-manure is much used in the west of Yorkshire, Holderness, and Lincolnshire. The usual quantity per acre is 70 bushels, when used alone; but when mixed with ashes or other common manure, 30 bushels per acre is said to be enough. When coarse, and applied in the same manner as other manures, it has been found to remain upwards of seven years in the ground, the productiveness of which it has increased during the whole time.

BONE′-GLUE. See GELATIN.

BONE′-GREASE. From refuse bones, bruised, boiled in water, and the broth skimmed when cold. *Prod.* 1-8th to 1-4th of the weight of the dry bones (*Proust*). Used for making soap and candles. See CHARCOAL, ANIMAL.

BONE′-PHOSPHATE. See TRIBASIC PHOSPHATE OF LIME.

BONE′-SHAVINGS. *Syn.* BONE′-DUST (Turners'), BONE-TURNINGS. This, by boiling with water, yields a beautiful jelly, which is nearly equal to that produced from hartshorn and ivory shavings, for which it is very frequently sold. Used to make jellies and blancmanges, to stiffen straw bonnets, &c.

BONE′-SPAVIN. A bony enlargement on the antero-internal parts of the hock in horses. In recent cases it is best to apply cold applications, but in protracted and chronic cases, hot fomentations will be found best. In case of these failing, recourse should be had to blistering or firing, or if need be to a seton.

BOOK′BINDING (-bīnd-). Although a full description of the various operations of this well-known art, or handicraft, does not properly fall within the province of this work, a brief notice of them will probably, in many cases, prove useful to the amateur and the emigrant:

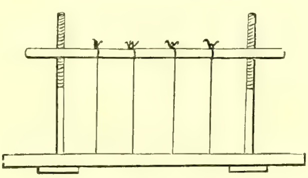
The process of binding books is divided into several distinct operations, which, in large establishments, are usually performed by different persons; such a method being found to produce greater expedition and better work than when the whole is done by one person.

The sheets received from the hands of the printer are—

1. *Folded,* which is done correctly by observing the 'marks' or 'signatures' at the bottom of the pages. As the sheets are folded they are laid upon each other in proper order, and are ready to undergo—

2. The operation of beating. This is performed by either laying them upon a large stone and striking them with a heavy smooth-faced hammer, or by passing them through a rolling-press. The former method is usually adopted in the small way, and the latter on the large scale.

3. The sheets are next fastened to bands, which is done by taking them up one by one, and sewing them to pieces of cord, stretched in a little frame screwed or fastened to the counter or table, called the sewing press. (See *engr.*) The number of



bands used is generally 6 for a folio, 5 for a quarto, and so on proportionately, less than 4 being seldom employed even for small sizes. The ends of the cords being cut off to within about 2 inches of the back, the sheets are ready for—

4. *Glueing.* The back being knocked into shape with a hammer, and the sheets placed in the cutting-press, which is then slightly screwed up, melted glue is thinly and evenly applied. After a short time, to permit it to become sufficiently set and hard, the book is removed from the press, and the back properly adjusted with a hammer, when it is again put into the cutting-press, where it is screwed up very tight, and is then ready for—

5. *Cutting.* The instrument employed for this

purpose is of a peculiar shape, and called a plough or plough-knife, which consists of a stout flat knife, double-edged at the 'cutting-point,' firmly set in a kind of frame, in which it may be adjusted by screws.

6. *Affixing the Boards.* The bands are now scraped out fine at the ends, and fastened to the pasteboard intended to form the covers, which is then properly adjusted, and further shaped, if necessary, with a large pair of shears. The edges now undergo the operation of—

7. *Sprinkling, gilding,* or other adornment. The first is performed with a stiff brush made of hog's bristles, dipped in a little colour; the brush being held in the one hand, and the hairs moved with the other, so as to scatter the colour in minute drops equally over the surface.

8. The external covering of leather, fancy cloth, or paper, is now applied, having been previously soaked in paste, to make it properly adhere. One or more of the blank leaves of the book are next pasted against the inside of the cover, to screen the ends that are turned over when the book is finished; or, for choice work, is handed to a 'finisher' for—

9. *Lettering, Gilding,* &c. Ordinary gold-leaf is applied by means of white of egg, the pattern being given by pressure with heated brass tools, having a design or letters on their surfaces. The whole is then glazed over with white of egg and polished.

10. *Burnishing Book Edges.* This is performed with a wolf's or dog's tooth, or a steel burnisher. Place the books in a screw press, with boards on each side of them, and other boards distributed between each volume. First rub the edges well with the tooth to give them a lustre. After sprinkling, or staining, or when the edges have become dry, burnish the front; then turning the press, burnish the edges at the top and bottom of the volume. Burnish the gilt edges in the same manner, after having applied the gold; but observe in gilding to put the gold first upon the front, and allow it to dry; and on no account commence the burnishing until the gold is quite dry.

The success of the above operations sometimes slightly varies with the workmen, and with the nature of the binding. The examination of a bound book during their perusal will, however, render the whole quite familiar to the reader.

There are several varieties of binding, of which only the following deserve notice here:

BOARDS. A book rather loosely done up, without cutting the edges, and covered with coloured paper or cloth, is said to be in 'boards.'

CLOTH, CLOTH-BINDING. This is the style of binding in which the majority of works are now issued. It admits of great neatness and even beauty, is cheap, and when well executed is very durable.—The prepared cloth (hard-glazed or varnished calico), cut by a pattern to the proper size, is passed rapidly between the engraved cylinders of a rolling-press, by which the design is given to it. Paste is now applied to each piece of cloth, which is then placed over the volume previously prepared to receive it. In many cases the covers are prepared separately before being embossed, and are afterwards fastened in the finished state to the book by means of a piece of canvas or calico previously affixed to its back for the purpose, when all that is required is to paste the ends of it to the inside of the boards, with the last blank leaf over it. Books in cloth are seldom cut at the edges, unless they are otherwise highly finished.

HALF-BINDING. Books forwarded in boards, and finished with leather backs and corners, are said to be 'half-bound.'

LEATHER-BINDING. A book is only said to be 'bound,' or 'fully-bound,' when both its backs and sides are wholly covered with one piece of leather.—The leather is wetted by immersion in water, wrung or squeezed, stretched on a smooth board, cut to the proper size, pared thin on the edges, and covered with paste. It is then applied to the book (previously forwarded in boards, and cut), drawn tightly over it, turned down on the inside, rubbed smooth with a folding-stick, and otherwise adjusted; after which it is placed in some suitable situation, at a distance from a fire, to dry.

Rough calf requires to be damped on the grain side with a sponge and water before pasting and covering.

Russia-leather is well soaked in water for an hour, taken out, beaten, and rubbed; after which the paste is well worked into the flesh side before covering.

Morocco is first 'grained' by rubbing it on a board, with the grain side inside, and, after being pasted, left to soak for about a quarter of an hour; after which it is drawn on with a piece of woollen cloth, to preserve the grain.

Roan is either soaked in water, or left to soak when pasted.

SCHOOL-BINDING. Originally applied to school-books strongly sewn and 'done up' in sheepskin, which was either left of a plain brown, or sprinkled or marbled with copperas water. Similar works of a cheaper class are now often 'done up' in canvas, brown-holland, and even coarse and strong coloured glazed calico.

Concluding Remarks. Numerous patents for improvements in binding books, several of which possess very great merit and usefulness, have been obtained during the last 30 years. Among these, one known as 'Hancock's Patent Binding,' from its extreme novelty, simplicity, durability, and inexpensiveness, deserves a passing notice here. By Mr Wm. Hancock's method the sheets are folded in double leaves, and by being properly placed together and adjusted (by setting them vertically, with the edges forming the back of the book downwards, in a concave mould so formed that whilst giving shape it may leave the whole breadth and nearly the whole length exposed), and firmly secured by a few turns of packthread, the book is subjected to the action of a press, and a strong and quick-drying solution of india-rubber is smeared over the back with the finger, when the whole is left for 3 or 4 hours, or longer, to dry. The operation is repeated as often as necessary, after which fillets of cloth are cemented on with the same varnish, and the book is ready to have the boards attached. The sheets of books that cannot be folded in 'double leaves' may be strongly stitched through, separately,

before adjusting them in the mould. In this way several of the usual operations of binding are dispensed with. We most willingly bear testimony to the strength and durability of this method, as well as to the great convenience it affords in allowing the books to open perfectly flat upon a table, or to be distorted in any possible manner, without injury to their backs. It is, undoubtedly, the best way of binding books for travellers. The Editor of the last edition of this work once had a large trunk of books, among which was a massive volume bound on Hancock's plan. All the rest were nearly torn to pieces by a few months' journey, but this one remained uninjured even after five years, during which time it accompanied him in his travels, extending, collectively, to upwards of 23,000 miles. See GILDING, MARBLING, SPRINKLES, STAINS, &c.

BOOKBINDING, to Preserve. Gas is, perhaps, the greatest enemy of books; bookshelves should never be higher than four feet from the top of the room, and a ventilator for the escape of heated air should be provided near the ceiling. Hot rooms are also destructive to books, and though a very dry atmosphere is prejudicial a damp one is even worse, and will cause great damage. When leather bindings show a tendency to crack, a dressing of clean paste well rubbed in and all excess removed with a damp cloth will sometimes arrest the decay of the leather for a time; bookbinders' varnish is useful in some cases. Vaseline has been recommended; milk will often render vellum more pliable, and is the best material for cleaning it. Prevention is perhaps the safest plan; books should never be read on the knee in front of a hot fire; no leather work can withstand such a process of baking; the beginnings of the destruction of bindings may often be traced to this cause. The modern plan of stitching with wire is a fertile source of trouble, and no book of the slightest value should be stitched in this way; rust and consequent staining of the pages is certain to occur, and the binding is rigid and inflexible.

Mildew, it is said, may be prevented by rubbing the leather with some essential oil, *e.g.* birch or cedar. Bookworms may be killed by the cautious application of benzine.

Yolk of egg well beaten up is a good application for rusty leather bindings; clean with a dry cloth and apply the yolk with a sponge; a hot iron will give it a polished surface.

BOOKBINDERS' VARNISH. 3 pints of strong methylated spirits of wine, 8 oz. shellac, 8 oz. gum sandarach, 2 oz. gum mastic (best), 2 oz. Venice turpentine.

BOONEKAMP OF MAAGBITTER. Dried orange berries, 100 grms.; bitter orange peel, 30 grms.; gentian root, 60 grms.; cascarilla bark, 30 grms.; turmeric, 15 grms.; cinnamon, 25 grms.; cloves, 15 grms.; rhubarb, 7½ grms.; 90% spirit, 750 grms.; water, 1650 grms.; star-anise oil, 40 drops; sugar, 250 grms.; digested, expressed, and filtered. (*Hager.*)

BOOT-POWDER. French chalk reduced to powder by scraping or grating. Used to facilitate the 'getting on' of new or tight boots, a little of it being rubbed on the insides of the backs, heels, and insteps.

BOOT-TOP LIQUID. *Syn.* BOOT'-TOP COMPOSI''TION. There are numerous articles of this class extant, but, with few exceptions, they are most unchemical mixtures, not infrequently containing ingredients which are either unnecessary, or opposed to the action of the rest. The following are examples:

Prep. a. WHITE-TOP: 1. Oxalic acid and white vitriol, of each 1 *oz.;* water, 1½ pint; dissolve. It is applied with a sponge, the leather having been previously washed with water; after a short time it is washed off with water, when the boot-tops are either dried in a current of air or by a gentle heat; they are lastly either polished with a brush, so as to appear like new leather, or they are left rough, as the case may require.

2. Sour milk, 1 quart; butter of antimony, cream of tartar, tartaric acid, and burnt alum, of each 2 *oz.;* mix.

3. Sour milk (skimmed), 3 pints; cream of tartar, 2 *oz.;* alum and oxalic acid, of each 1 *oz.*

4. Alum, cream of tartar, magnesia, and oxalic acid, of each, 1 *oz.;* salt of sorrel and sugar of lead, of each, ¼ *oz.;* water, 1 quart. The preceding are for white tops.

b. BROWN-TOP: Alum, annatto, and oxalic acid, of each, 1 *oz.;* isinglass and sugar of lead, of each, ½ *oz.;* salt of sorrel, ¼ *oz.;* water, 1 quart; boil for 10 minutes.

c. Saffron, 15 gr.; boiling water, 2 *oz.;* infuse and strain. Add tincture of rhubarb, 1½ *oz.;* concentrated infusion of rhubarb, to make up to 4 *oz.*

BOOTS and SHOES. The cleaning of boots and shoes forms no unimportant part of the domestic duties of a large establishment; as on it being properly performed depend both their appearance and durability. To effect this object in the best style, all that is necessary is to employ very little blacking (merely enough to moisten the surface of the leather), and to brush it off whilst still damp. Never make the surface wet, nor allow the blacking to dry before applying the polishing brush. For this purpose a portion only of the boot or shoe should be attended to at a time. The dirt is, of course, to be carefully brushed off before applying the blacking. When it is desired to restore the shape of a boot or shoe, as well as to clean it, boot trees may be used. Of the brushes, we are told that there should be at least three—one (dirt brush) with bristles stiff, but not wiry nor scratchy, to remove mud and dirt; another (blacking-brush), with fine, flexible hair, and plenty of it, for applying the blacking; and a third (polishing-brush), covered with long, fine, springy, and slightly stiff hair, for giving the polish. The employment of inferior or worn-out brushes is said to be false economy, and proves particularly destructive to the lighter classes of leather.

The occasional use of a little oil or grease to the uppers of boots and shoes increases their softness and durability, as well as the 'depth,' but not the brilliancy of the polish, from common blacking. For this purpose some good tallow or 'dubbin' may be used; the absorption being aided by a very gentle heat. The soles or bottoms of new boots and shoes may be thoroughly saturated with similar substances, by which means their dura-

bility will be fully doubled. The common practice among the shoemakers is to moisten the surface of the leather with a wet sponge before applying the oil or grease; by which (they say) its pores are opened and its absorbent powers increased.

The constant use of blacking, even of good quality, is very destructive to leather, and it is well to give boots an occasional thorough washing with water and a hard brush, to remove excess of blacking and every trace of mud. Wipe off the excess of water, warm slightly before the fire, and then rub in as much dubbin as the leather will take up.

Varnish for Boots and Shoes. **1.** Boil together in a pipkin 1 pint of linseed oil; ½ *lb.* of mutton suet, the same quantity of beeswax, and a small piece of resin; and when the mixture becomes milk-warm, apply it with a hair brush. After two applications the articles will become waterproof. Great caution must be exercised in melting the above ingredients, lest the mixture boils over, and so gives rise to a conflagration.

2. Common tar may be made warm and brushed over the soles of boots or shoes. These latter are then put near the fire so that the tar may be absorbed. When the absorption has taken place, a second or third application may be given with advantage. This application is not suitable for the upper leathers.

3. India-rubber varnish will be found very useful for anointing the upper leather of boots and shoes; but the lower parts, which are exposed to the wear and tear caused by friction with the ground, are but little benefited by its application.

Patent-leather boots and shoes are best cleaned with a little sweet oil or milk (preferably the first), the dirt having been previously removed in the usual way.

India-rubber goloshes and overshoes may be cleaned with a sponge or brush, and water, care being taken not to wet the linings. The same applies to gutta percha. See BLACKING, LEATHER, WATERPROOFING, &c.

The reasons why boots and shoes so commonly cause corns, and fatigue, and give pain in wear, are explained in the article on the FEET (which *see*).

Paramount in importance to the appearance of boots or shoes on the wearer is the desideratum, not only of having them so made as to ensure personal comfort in walking, but additionally to have them so constructed as to protect the feet from wet during damp and rainy weather. The evils arising from getting the feet damp cannot be overstated; amongst them are to be included —cold, cough, bronchitis, inflammation of the lungs, and rheumatism. In those inheriting a constitutional consumptive taint, a cold caught from wearing damp or leaky boots has very frequently been known to have accelerated the disease, that has ended in more or less speedy death. Hence arises not only the duty of changing damp boots or shoes as soon as ever the opportunity offers, but the wisdom of adopting the preventive precaution of wearing them of such stout construction as to be impervious to water during rainy weather. If the dangers arising from a neglect of this advice are visited with such serious consequences upon adults and grown persons, they affect infants and children with even far greater intensity, because of the much more tender and sensitive organisation of the latter. It therefore behoves every mother not only to see that her children are shod with good thick boots or shoes, but to take especial care that whenever these are damp they are removed at once.

Mr Chavasse, in his excellent work, 'Counsel to a Mother,' recommends "boots for walking out of doors and shoes for the house." He adds, "that the constant wearing of boots in the house is weakening to the ankles, as weakening as tight lacing is to the waist; indeed it acts much in the same way, namely, by wasting away, by pressure, the ligaments of the ankles, as stays waste away the muscles of the waist." In support of his argument he quotes Dr Humphry, who says, "The notion is in both instances fortified by the fact that those persons who have been accustomed to the pressure either upon the ankle or upon the waist, feel a want of it when it is removed, and are uncomfortable without it. They forget, or are unconscious, that the feeling of the want has been engendered by the appliance, and that had they never resorted to the latter they would never have experienced the former." The deduction to be drawn from Dr Humphry's opinion is that no more fertile source of weak ankles exists than that of wearing laced boots during childhood. Boots with elastic sides, as exerting much more equal pressure, and allowing full scope for the ankles to play, are far preferable to tightly laced-up boots.

BORACIC ACID (-răs-) H_3BO_3. *Syn.* ORTHOBORACIC ACID; BORIC ACID. ACIDIUM BORICUM, L.; ACIDE BORACIQUE, A. BORIQUE, Fr.; BORSÄURE, Ger.

Sources. This acid occurs free in the waters of many volcanic districts, especially in the lagoons of Tuscany. It is supposed to be produced in volcanic districts by the action of steam at a high temperature upon either nitride or sulphide of boron, thus:

$$BN + 3H_2O = H_3BO_3 + NH_3;$$
$$B_2S_3 + 6H_2O = 2H_3BO_3 + 3H_2S.$$

It is also found in combination with metallic oxides (see its *Salts*).

Till quite recently almost the whole of the boracic acid of commerce was obtained from Tuscany, but now large quantities are manufactured from the borates found in North and South America.

Prep. 1. (On the small scale.) 1 part of borax is dissolved in 4 parts of boiling water, and sulphuric or hydrochloric acid is added until the solution acquires an alkaline reaction. As the solution cools, crystals of boracic acid are deposited. The acid thus obtained is nearly pure; it may be further purified by recrystallisation, or by first igniting it in a platinum crucible, and then recrystallising it.

2. Boracic acid is prepared in America on the large scale from borax, by dissolving it in hot hydrochloric acid, and recrystallising the boracic acid—which separates out on cooling—from hot water.

3. It is also prepared on the large scale in

Tuscany by evaporating the water of the boracic acid lagoons, this being largely accomplished by means of the heat derived from the volcanic jets of steam, or *suffioni*, which abound in the neighbourhood of these.

Prop. Boracic acid forms shining six-sided laminæ, unctuous to the touch; it contains 3 molecules of water chemically combined ($B_2O_3.3H_2O$), =43·5%, which is lost upon ignition, the anhydride (B_2O_3), a brittle glassy substance, being left behind. It dissolves in 25 parts of cold, and in 3 parts of boiling water; also in 16 parts of rectified spirit at 15·5° C. (60° F.), and in 4 parts of glycerine. The solution in glycerine has been used as an ointment; by cooling a solution in hot glycerine a crystalline compound may be obtained. Boracic acid has but very feeble acid properties, and colours litmus only a faint wine-red; but, its anhydride being non-volatile, it displaces strong acids from their salts when heated with these.

Uses. Boracic acid was once administered internally, in large doses, as an anodyne, antispasmodic, and sedative, but is now scarcely ever employed as a medicine. The crude acid is used in the manufacture of borax; the pure acid in the manufacture of certain chemicals. In *surgery*, it is much used as a mild antiseptic in the form of lotion, 1 oz. to a quart of water. Boric lint, made by dipping lint in a hot saturated solution of the acid, then drying, is a valuable surgical dressing.

Boracic acid is extensively used in Sweden and other countries for the preservation of milk, meat, and fish. Meat which has been soaked in a solution of the acid for a few seconds, and milk to which a small quantity has been added, will keep much longer than they would otherwise do. In Sweden alone boracic acid to the value of £75,000 was consumed in one year. It has been recently shown that boracic acid, even in small doses, has a bad effect on the digestive organs, causing an increase in the proportion of solid and nitrogenous matter in the fæces; its use as an antiseptic and preservative is therefore undesirable.

Salts. Of these the chief are *borax*, $Na_2B_2O_7$ (which *see*), a borate of sodium; *boro-natro-calcite*, a mixture of borates of calcium and sodium, known commercially as *calcium borate*, which is found in Chili and Peru, and is used in the manufacture of borax; *boracite*, $MgBO_2$, a borate of magnesium usually mixed with some chloride, found in Asia Minor. A *borate of aluminium* has recently been discovered in East Siberia.

Tests for. 1. Barium chloride ($BaCl_2$), added to a neutral solution of a borate, gives a white precipitate of metaborate of barium, $BaBO_2$, which is soluble in hydrochloric acid.

2. If alcohol is added to a solution of free boracic acid, and the mixture ignited, the flame is edged with green. As copper salts also give this reaction, any copper which may be present must therefore be first removed by means of sulphuretted hydrogen. If we are dealing with a salt, plenty of strong sulphuric acid must be added, before the addition of alcohol, to set free the boracic acid contained in the salt.

3. If a slip of turmeric paper is moistened with a solution of a borate (previously made slightly acid, by the addition of hydrochloric acid), and then gently dried, a brown-red stain is produced, which is turned a dirty green by a solution of sodium carbonate; the red tint is, however, restored by hydrochloric acid. This test is exceedingly delicate and characteristic, and suffices to distinguish boracic from any other acid.

Estim. Either indirectly, or by weighing as potassium borofluoride ($KF.BF_3$). The process is too complicated to be given here; special works on analysis must be consulted.

BORACIC ANHYDRIDE, B_2O_3. *Syn.* Boric anhydride, Boric oxide, Anhydrous boracic acid. The only known oxide of boron. It may be prepared by burning boron in air, oxygen, or nitrous acid, or, better, by heating boracic acid so as to drive off the water which it contains, thus $2H_3BO_3 = 3H_2O + B_2O_3$. It is a brittle vitreous solid, not volatilised by heat excepting in the presence of water. It dissolves in water, forming boracic acid. Its solution in alcohol, like that of boracic acid, burns with a green flame.

BORATE. [Eng., Fr.] *Syn.* Bo′′ras, L.; Borsaure sälze, Ger. A salt of boracic acid (which *see*).

BORAX [Eng., Fr., Ger., L., Ph. B.], $Na_2B_4O_7$, $=Na_2O,2B_2O_3$. *Syn.* Pyroborate of soda, Biborate of soda; Borsaures natron, Ger. A sodium salt of boracic acid, containing 1 equivalent of soda combined with 2 equivalents of boracic anhydride.

Sources. It is found native, as tincal, in Thibet, Nevada, Chili and Peru; of late large quantities have been obtained from California.

Prep. 1. By purifying native borax.

2. From boracic acid by fusing it with sodium carbonate, dissolving the product in water, and allowing the concentrated solution to cool very slowly; borax is thus obtained in large crystals.

3. It is also prepared at Hamburg from boro-natro-calcite (commercially known as *calcium borate*), which is imported from Chili and Peru. The mineral is ground to powder and mixed with water, the mixture is heated by passing steam into it, and then soda and sodium carbonate are added. After a time the lye is drawn off into tanks and allowed to crystallise. Crystals of borax are thus obtained mixed with much sulphate and chloride of sodium; to get rid of these latter they are dissolved in hot water, and the solution is allowed to cool to 33° C. (91° F.), at which temperature the mother-liquor, which contains nearly all the impurities, is drawn off, and the crystals of borax, which have been deposited on the walls of the tank, are removed, and dried at 30° C. (86° F.).

Borax is made on the large scale by all of these methods; at one time method 2 was the only one used, but this has become much less important since the discoveries of borax and borates in California and South America.

Prop. Ordinary borax crystallises in large six-sided prisms, containing 10 molecules of water; these effloresce in dry air, and when heated lose all their water of crystallisation, fusing at a higher temperature to a transparent glass. They are soluble in 16 parts of cold and in half their

weight of boiling water, and the solution is alkaline to test-paper.

Pur. The value of a sample of borax is ascertained by titrating it with a standard solution of hydrochloric or sulphuric acid, a few drops of litmus solution being added. Boracic acid colours litmus reddish-purple, having scarcely any acid reaction; the standard acid is added till the litmus becomes bright red, the quantity of acid required being equivalent to the soda in the borax. Borax is sometimes adulterated with common salt and alum; the former may be recognised by the solution giving with silver nitrate solution a white curdy precipitate, insoluble in nitric acid, but soluble in ammonia; the latter by the solution giving a white flocculent precipitate with excess of ammonia solution.

Uses. Borax is extensively employed as a flux for metals, in soldering, as a constituent of some enamels, and in some tooth-powders; it is also used on the small scale in the chemical examination of substances by the dry way. (See BLOWPIPE.) Two preparations of it are mentioned in the 'Pharmacopœia;' (1) *Glycerine of Borax* (Glycerinum Boracis, B.P.), made by rubbing together in a mortar 1 *oz.* of borax with 4 *fl. oz.* of glycerine and 2 *fl. oz.* of distilled water. (2) *Borax honey* (Mel Boracis, B.P.), made by mixing 2 parts of powdered borax with 1 part of glycerine and 16 parts of clarified honey. Internally it is diuretic, sedative, emmenagogue, and refrigerant, in doses of 15 to 40 gr.; externally, made into a gargle for sore-throat, and in powder as a detergent in aphthæ, and ulcerations of the mouth. Dissolved in rose-water, it is used as a cosmetic; and mixed with about 8 times its weight of lard, forms a useful ointment in piles and sore nipples.

Experiments made on the physiological action of borax have shown that it possesses the power of coagulating protoplasm and destroying its vital activities. Leaves of plants, fungi, and animalculæ are quickly killed by immersion in a solution of borax; frogs' larvæ die after an hour's immersion. Borax is also able to prevent fermentation. Grapes and currants placed in a solution of it did not putrefy, though in some cases, when air was admitted, a slight fungoid growth took place; the fruit was, however, unfit to eat, as the sugar had diffused out through the skin. Meat kept for years in a solution of borax did not putrefy, but a peculiar odour was evolved, and though quite tender and fresh, the meat was unfit for consumption; all the red colouring matter had diffused out. Milk with a little borax added smelt quite fresh after keeping for months, but a slight mould had formed on the surface of the cream, and the casein was deposited. It thus appears that, though borax prevents fermentation, its use for the preservation of food is restricted; it was suggested, however, that it might form a cheap substitute for alcohol in preserving anatomical specimens. For further information on this subject see Schnetzler, 'Comptes Rendus,' 80, 469. See FOOD, PRESERVED.

Borax, Glass of. Obtained as a vitreous mass by drying borax at a gentle heat, and then fusing and allowing it to cool. Used in soldering, and as a flux, particularly in blowpipe experiments.

BORIC ACID. See BORACIC ACID.

BORIC ANHYDRIDE. See BORACIC ANHYDRIDE.

BOROGLYCERIDE. A compound which has been patented. Made by heating a mixture of 92 parts glycerine and 62 parts boric acid. It forms a pasty, partly fluid mass, soluble in water.

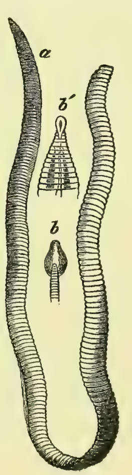
Uses. Mild antiseptic, surgical dressing.

BORON. Symbol B. Atomic weight = 11. A non-metallic element, which in some cases appears to react like a feebly metallic one. It is placed in the same group with aluminium and several other rare elements, which are of scientific interest only. In its properties it resembles carbon and silicon on the one hand, and nitrogen and phosphorus on the other.

Sources. It occurs naturally in combination with oxygen as BORACIC ACID, or as salts of that acid (BORATES). See BORACIC ACID.

Prep. 10 parts of fused boric anhydride (B_2O_3) in coarse powder are mixed with 6 parts of sodium in small pieces, the mixture is placed in an iron crucible heated to full redness, 4 to 5 parts of fused sodium chloride are added, and the crucible is covered. When all action has ceased, the molten mass is stirred with an iron rod, and the contents of the crucible, while still hot, are poured into water containing a little hydrochloric acid. Everything dissolves except the boron, which is left as an insoluble *amorphous* brown powder. It is washed with dilute hydrochloric acid, then with alcohol, and then with ether, and finally it is dried at a very gentle heat. Instead of boric anhydride, potassium borofluoride ($KF.BF_3$) may be used. The methods hitherto given for preparing *crystalline* boron have been shown to yield crystalline compounds of that element. Boron is not made on the large scale.

Prop. *Amorphous* boron is a brown insoluble powder, odourless, tasteless, and a non-conductor of electricity; it is very infusible, but melts in the electric arc. Its sp. gr. has not been determined, but is greater than 1·8. The different varieties of *crystalline* boron which have been described have been shown to be compounds of that element with aluminium, or with aluminium and carbon; the crystalline form being in the former case that of graphite, in the latter that of the diamond. The sp. gr. of so-called crystalline boron is about 2·6.



When heated in oxygen, boron burns, forming the oxide (B_2O_3); it also unites directly with sulphur, chlorine, bromine, and nitrogen, and when it is heated in air, both the oxide and the nitride (BN) are formed.

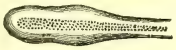
Tests. See BORACIC ACID.

Boron, Terflu'oride of. See FLUOBORIC ACID.

BOTHRIOCEPHALUS CORDATUS. Leuckart was the first to describe this creature, which is a parasitic worm infesting the human intestines. It is, however, much more commonly met with in dogs than in man. The annexed engraving depicts—*b*, the head

(back view), magnified 5 diameters; *b′*, upper part of body and head, magnified 2 diameters; *a* is a portion of the worm, natural size. See BOTHRIOCEPHALUS LATUS.

BOTHRIOCEPHALUS LATUS. A parasitic worm infesting the human intestines. Although classed with the tapeworms, it differs essentially from *tænia*. The head is of an elongated form, compressed with an anterior obtuse prominence into which the mouth opens.



The animal has the power of elongating and contracting the neck, so that it appears sometimes short, sometimes long. The joints or segments commence about 3 inches from the head; the anterior ones are nearly square, but the remainder are much elongated transversely. Each segment contains on its flat surface two orifices, the anterior connected with a male, the posterior with a female organ of generation. The parasite is of a brown colour, and from 6 to 20 feet in length.

Those who are affected by this worm never pass the single segments from the bowels, but void them in chains of many links. The ova are also frequently to be met with in the fæces; they are of an ovoid shape; the capsule is perfectly translucent, and the yolk is distinguishable. The yolk undergoes segmentation, and ultimately develops an embryo with 6 hooks at the anterior extremity, cased in a mantle studded with vibratory cilia, and the lid of the capsule then opens up; and then the embryo escapes. If they do not obtain access to the intestines of an animal within a week, they lose their ciliated mantle and perish. Drinking-water is supposed to be the chief if not the only medium through which the parasite gains admission to the intestines of man. It seems to be unknown in England, except when imported; but is common in Russia, Sweden, Norway, Lapland, Finland, Poland, and Switzerland.

BOTS. The larvæ of the gad-fly (*Œstrus*).

There are three species, which attack the horse, ox, and sheep respectively, laying their eggs on the hides of the younger animals (horse) about the shoulder, base of the neck, and inner parts of the fore legs. These parts THE HORSE licks, and carries the maggots as they are hatched to the stomach, where they attach themselves by means of hooks and remain till they attain full growth. They then loosen their hold, and are expelled with the fæces. They often cause great irritation whilst in the alimentary canal. Arrived outside the body, they bury themselves in the ground, and undergo the change to the pupa state, and about six weeks afterwards emerge as perfect insects. They remain in the alimentary canal of the animal as maggots for about 8 months. Another species—*Œstrus hæmorrhoidalis*—lays its eggs on the nostrils and lips of the horse.

In the OX, the *Œstrus bovis* lays its eggs in the hide, producing perforations and small inflamed tumours or warbles, inflicting great pain on the animal, and damaging or destroying the hide for tanning purposes. The bots of the ox do not enter the alimentary canal, but simply fall out of their holes in the skin to the ground to undergo metamorphosis.

Sheep bots—*Œstrus ovis*—attack the nostrils, and the maggots as they are formed creep up the nasal cavities into the frontal sinuses, where they attach themselves, causing terrible pain and irritation. When matured they loose their hold and drop out, undergoing the pupa stage in the ground, like the other species.

Prevention. About the end of April rub the backs of the animals with train-oil, or a mixture of train-oil and tar. The odour seems to be distasteful to the insects, and they will not approach beasts so anointed.

Remedies. These are very simple, and being chiefly mechanical in their action, require careful application; anything which will stop up the hole in a warble, *e.g.* tar, grease, or cart-grease and sulphur applied with the finger to EACH WARBLE, so as to choke the maggot. Careful watching of the beasts and patience in their treatment will do much to prevent or cure warbles, the damage done by which is by no means properly realised.

BOT′TLES (bŏt′lz), See GLASS, INFANCY, LACTATION, PHIALS, &c.

BOTT′LING (bŏt′l-ing). See CORKS, MALT LIQUORS, WINE, &c.

BO TREE. The sacred Buddhist tree of Anarajapoora, planted about B.C. 288; probably the oldest historical tree in the world—*Ficus religiosa.*

BOUGIE (bōō′-zhē). [Fr.] *Syn.* CE′REUS, CERE′OLUS (properly, a 'little bougie'), CANDE′LA PROBATO″RIA*, L. In *surgery*, a long slender instrument, originally of wax (hence the name), introduced into the urethra, œsophagus, or rectum, in stricture and other diseases of those organs. Medicated bougies are now much used having a basis of cocoa butter, or of gelatine; length about 4 inches, and cast in metal moulds.

Prep. 1. (*Prof. Pickel's.*) Amber (melted), 1 part; boiled oil, 3 parts; mix, cool a little, and further add of oil of turpentine, 1 part; spread the mixture, at 3 successive intervals, upon loose spun-silk cord or web; dry in a heat of 150° F., and repeat the process until the instrument has acquired the proper size; lastly, polish it, first with pumice-stone, and afterwards with tripoli and oil. This is the original receipt of the once celebrated French professor, Pickel, and is still generally used, slightly modified, on the Continent. At the present time, in Paris, a little caoutchouc, equal to about 1-20th of the weight of the oil employed, is generally added. For the best ELAS′TIC BOUGIES the process usually occupies from 6 to 8 weeks, to allow full time for the drying and hardening of the composition. When the bougie is required to be hollow, a piece of polished metallic wire is introduced into the axis of the silk; or tin-foil is rolled round the wire and the composition applied as before. When dry and hard the wire is withdrawn.

2. (*Cheyne.*) IODOFORM AND EUCALYPTUS BOUGIES FOR GONORRHŒA. Iodoform, 5 gr.; oil of eucalyptus, 10 min.; oil of theabroma, 35 gr., in each bougie. The bougie should be cast in a mould, and made of the length of 4 inches, and diameter of a No. 10 catheter.

3. (*Hunter's.*) Yellow wax, 2 parts; red lead, 3 parts; olive oil, 6 parts; slowly boiled together until combination takes place; strips of soft linen (rather wider at the one end than the other) are then dipped into the composition, rolled up firmly, and finished off on a polished slab.

4. (*Piderit's.*) Olive oil, 1 part; wax, 6 parts; as before.

5. (*Bell's.*) Lead-plaster, 11 parts; yellow wax, 4 parts; olive oil, 1 part.

6. (*St B. Hosp.*) Wax, 12 parts; Chio turpentine, 4 parts; red sulphide of mercury, 1 part.

7. CAOU'TCHOUC BOUGIES. In France, where ether is comparatively inexpensive, these are made by applying an ethereal solution of india-rubber to the silk or foil prepared as before. In England, naphtha was, until recently, employed instead of 'ether,' but it furnishes a very inferior product. Now bisulphuret of carbon is generally used as the solvent. Sometimes strips of india-rubber, previously boiled in water, or that have had their edges softened by moistening them with a little ether, or bisulphuret of carbon, are wound round the 'wire or foil,' and kept in their place by a piece of tape applied over them. They are afterwards carefully smoothed off and polished.

8. GUTTA-PER'CHA BOUGIES. These are formed of gutta percha (previously softened by immersion in boiling water), by rolling it between plates of polished glass or marble. When skilfully prepared from the best (uncoloured) gutta percha, they are admirable instruments. A bougie of this description, of moderate size, and slightly oiled, or wetted with glycerine or gum-water, may be passed through the whole length of the urethra of a healthy person without causing the slightest pain. Gutta-percha catheters (hollow bougies) are still more flexible and easily introduced, and may remain in the urethra for a long time without causing irritation—an important advantage in such matters. The reader cannot, however, be too careful to avoid those made of coloured gutta percha, which, unfortunately, rapidly become very brittle by age. Those originally manufactured in this material were coloured black, and were constantly breaking whilst in use—a disaster from which several serious and even fatal cases ensued. There is no such danger to be dreaded from those made of the uncoloured material when of good quality.

9. BOUGIES OF HYDROCHLORATE OF COCAINE. *Bouginaria cocainæ hydrochloratis.* These are made with a gelatine glycerine basis so as to contain in each bougie $\frac{1}{6}$ to $\frac{1}{2}$ gr. of hydrochlorate of cocaine. They are useful in hay fever when inserted in the nasal cavity.

BOUILLI. [Fr.] A name frequently applied by cooks to dishes of boiled or stewed meat, as a refinement on its plain English synonymes. Thus, beef bouilli, beef in bouilli, &c., mean stewed or boiled beef, &c. As, however, the name is *à la française*, so must be the 'accompaniments,' which generally consist of herbs and vegetable seasoning in greater quantity and variety than is usually deemed essential for an humble dish of English boiled or stewed meat.

BOUILLON (bōōl'-yong). [Fr.] In *cookery*, broth, soup.

BOULES DE NANCY. See BALLS (Martial).

BOUQUET' (bōō-kā'). [Fr.] A nosegay. In *perfumery*, highly scented spirits (esprits) adapted for the handkerchief are commonly called bouquets. The following are examples:

Bouquet d'Amour. *Prep.* From esprits de rose, jasmin, violette, and cassie (flowers of *Acacia farnesiana*), of each, 2 parts; essences of musk and ambergris, of each, 1 part; mix, and filter.

Bouquet de la Reine. *Prep.* 1. Essence of bergamot, 1 dr.; English oil of lavender, 25 drops; oil of cloves, aromatic vinegar, and essence of musk, of each, 10 drops; alcohol, 1 fl. oz.; mix.

2. Oils of bergamot and lavender, of each, 30 drops; neroli, 15 drops; oils of verbena and cloves, of each, 5 drops; essences of musk, ambergris, and jasmin, of each, $\frac{1}{2}$ dr.; rectified spirit of wine (strongest, scentless), 2 fl. oz.; mix. A much-esteemed perfume.

BOW-WOOD. The wood of *Maclura aurantiaca*, the OSAGE ORANGE. A North American tree whose leaves have been used as a substitute for mulberry in feeding silk-worms. The yellow juice was formerly used as a war-paint by the Indians.

BOXWOOD. *Buxus sempervirens*, Linn. A well-known evergreen tree of Europe, growing in some situations in Britain. Its dense, compact wood is admirably suited for the use of wood-engravers, for graduated scales, &c. Russia and Persia are the principal sources of boxwood of commerce, but the supplies of late years have been decreasing. A hard even-grained wood that would prove a perfect substitute for boxwood has yet to be discovered.

BRA'GRAS. Tar, black resin, and the dregs of strained resin, melted together.

BRAIN (brāne). *Syn.* BRAINS‡; CER'EBRUM, L.; CERVEAU, Fr.; GEHIRN, HIRN, Ger. The soft whitish mass of nerve-matter contained in the skulls of animals, and, in man; the upper end of the central nervous system.

Brains. (In *cookery.*) There appears to be scarcely anything which is at all eatable that the ingenuity and taste of the modern cook does not appropriate to his purposes, and clothe with delectability, or transform into something eatable. Animals which were guiltless of brains whilst living, are found by him to possess excellent ones when dead, from which he prepares a variety of miniature dishes which are truly novel and inviting. Let frugal housewives for the future carefully value their brains, and apply them to useful purposes in a double sense. When cleaned, washed, blanched, and flavoured with the necessary seasoning, they may be formed into a variety of *hors-d'œuvres* creditable to any table. Mrs Rundell tells us that "beat up with a little white pepper and salt, a sage-leaf or two (scalded and finely chopped), and the yelk of an egg, and fried, they make excellent cakes, fritters, &c."

BRAMAELIXIR—GENUINE ASIATIC STOMACH BITTER. (*Ch. Rama Ayen*, Hamburg.) Cardamoms, cinnamon, cloves, of each, 15 grms.; galangal, ginger, zedoary, pepper, of each, 30 grms.; wormwood oil, 15 drops; 90% spirit, 830 grms.; water, 330 grms.; digest and filter (*Hager*).

BRAN. *Syn.* FUR'FUR, L.; BRAN, SON, Fr.; KLEIE, Ger. The inner husk or proper coat of

the cereal grains, sifted from the flour; appr., that of wheat. *Comp.* 100 parts of bran contain albuminoid bodies, 13·80; oil, 5·56; starch, fibre, &c., 61·67; ash, 6·11; water, 12·85.

Uses, &c. The bran of wheat, diffused through hot water, is largely employed by the calico-printers to remove the colouring matter from those parts of their goods which are not mordanted. A handful mixed with a pail of warm water forms an excellent emollient foot-bath. Infused in hot water (bran-tea), and sweetened, it forms a popular demulcent, much used in coughs and hoarseness, and which, taken in quantity, proves gently laxative. It also forms an excellent manure, and, from containing the ammonio-magnesian phosphate, is especially adapted as a 'dressing' for potatoes. It is frequently mixed with flour and made into bread (bran-bread), which is eaten by the poorer orders for economy, and by the higher classes because it is recommended by the faculty as being more wholesome than white wheaten bread. See BREAD.

Bran Mash. Put half a peck of bran or pollard into a bucket and pour on to it enough scalding water to wet it thoroughly; stir well with a stick or work with the hands; and let it stand, covered up, till new-milk warm. If a horse is not in work on Sunday, it is a good custom to give it on Saturday evening a bran mash in lieu of a feed of corn. Bran mash is cooling and slightly laxative. The bran should always be freshly ground. When intended to be nutritive, oats should be scalded with the bran.

BRANDISH'S ALKALINE (Liqueur de potasse des Anglais, Solutio Alkalina Anglica), used in England to add to meat and vegetables about to be cooked, to help in 'drawing' tea and coffee, and as a medicine to neutralise acidity of the stomach and lubricate the digestive passages [die Verdauungswege schlüpfriger zu machen]. *Prep.* Crude carbonate of potash, 3 parts; wood ashes, 1 part; quicklime, 1 part; warm water, 40 parts. Add to the water the lime, carbonate, and ashes, digest one day, and filter (*Hager*).

BRANDRETH'S PILLS, much used as a purging pill in North America, consist of gamboge, podophyllin, the inspissated juice of pokeberries, saffron adulterated with turmeric, powdered cloves, and peppermint oil. Gamboge is stated to be present in Brandreth's pills on the authority of two American druggists and one dealer. The action of the pills does not, however, correspond with that ingredient, for in two persons five pills produced no loose stools (*Hager*).

BRAN'DY. *Syn.* SPIRI'TUS GAL'LICUS, S. VI'NI GAL'LICI (-sī); B. P.), A'QUA VI'TÆ†*, L.; EAU-DE-VIE, Fr.; BRANNTWEIN, COGNAC, Ger.; BRAN'DYWINE†. A well-known spirituous liquor obtained by the distillation of the wine of grapes. The name is also often, though improperly, given to the spirit distilled from other liquors, and particularly from the fermented juice of fruits; but in this case usually with some qualifying epithet.

When first distilled, brandy, like other spirituous liquors, is colourless (WHITE BRANDY), and continues so if kept in glass or stoneware; but if stored in new oak casks, as is usually the case, it gradually acquires a yellowish tint from the wood (PALE BRANDY). The deep colour that this spirit frequently possesses when it reaches the consumer is imparted to it by the addition of a little burnt sugar (caramel). Catechu, or terra japonica, in powder or solution, is also sometimes added to give a roughness to the spirit. The original intention was merely to imitate the appearance acquired by brandy from great age, when kept in wood; but this is often overdone. The natural colour which the spirit receives from the cask, however long it may be kept in it, never exceeds a light amber tint, about equal to that of pale Jamaica rum. The public taste requires a spirit of full 'brandy-colour,' as it is called. The consequence is that more colouring is commonly added than is compatible with a fine flavour.

The brandies most esteemed in England are imported from France, those of Cognac and Armagnac being generally preferred. The brandies of Rochelle and Bordeaux come next in quality; while those of Portugal, Spain, and Italy are very inferior.

The constituents of pure brandy are alcohol and water, together with small quantities of a volatile oil, acetic acid, acetic ether, œnanthic ether, colouring matter, and tannin. It is from the presence of the two ethers that the spirit derives its characteristic smell and flavour. The amount of absolute alcohol in brandy varies from 45% to 55%. When first imported it is generally 1 or 2 over-proof, but its strength decreases by age, and by the time it is taken from the bonded store for sale, it is seldom stronger than 3 or 4 under-proof. Pure brandies of the best quality, even when new, seldom exceed proof, and are generally a little below it. The reason of this is that they are but slightly rectified, as redistillation tends to injure the ethereal oils, upon which their flavour depends.

The quality and flavour of the brandy imported from France vary, and often considerably, from that which is drunk at the best tables on the Continent; this principally arises from it being prepared, or, as it is technically termed, 'made up,' for the London market; which means lowering it by the addition of plain spirit, colouring, &c. The strength at which foreign brandy is sold in England varies from proof to 33 under-proof. In large quantities, and from bond, the strength, of course, depends much upon the age and quality of the spirit; a fine old brandy being, perhaps, 15 or 17 u. p., while one of the last year's vintage, of a commoner quality, may be as strong as 2 u. p., or even 1 u. p.

In France there are several varieties of brandy, which are known by names descriptive of their qualities, source, and strengths:

'Eau-de-vie supérieure' is obtained from pale white wines by skilful distillation, and is remarkable for its rich and delicate flavour. It forms the finest variety of COGNAC BRANDY, both 'white' and 'pale,' of the English drinker, being seldom artificially coloured. Its deepest tint, though long kept in wood, never exceeds a pale amber; and hence, even when thus coloured, it is frequently called 'white brandy' by the uninitiated.

'Eau-de-vie ordinaire,' or common brandy, is distilled from inferior or spoilt white or red wines; average sp. gr. about 0·9476 (from 22 to

27 u. p.) It forms the 'ordinary brandy' of the taverns and hotels; and, after being 'made up' with plain spirit to 1 or 2 u. p., a very large portion of that which is exported.

Of each of the above varieties there are numerous degrees of qualities, which are further increased in number by their admixture, and by the addition to them of plain spirit.

'Eau-de-vie de marc.' From the lees of sour, damaged, and inferior red wines, the marc or cake of grapes, &c., distilled by a quick fire, to drive over as much essential oil and flavouring matter as possible. Coarse flavoured and inferior. Used chiefly to mix with other brandy, or to flavour plain spirit.

'Eau-de-vie seconde.' The weak spirit that passes over after the receiver has heen changed. Very weak and inferior.

'Eau-de-vie à preuve d'Hollande.' Sp. gr. ·941 to 942 (18 to 20 u. p.). The common strength at which brandy is retailed in France, and that at which it stands the 'proof' or 'bead.'

'Eau-de-vie à preuve d'huile.' Sp. gr. ·9185 (about 23° Baumé, or 1¼ o. p.); pure, olive oil just sinks in it. It is the strongest brandy kept for retail sale in France.

'Eau-de-vie forte.' From common brandy distilled at a low temperature. It answers to our spirits of wine. Sp. gr. ·839 (38° Baumé, or 55° o. p.).

'Esprit de vin' is brandy or spirit, carefully rectified to ·861 (28° Baumé, or 42° o. p., and upwards).

Pur., &c. The method of determining the strength of brandy is explained under 'ALCOHOLOMETRY.' Of the large quantity of this liquor consumed in England a small fraction only escapes adulteration. Pure French brandy is indeed an article very difficult to obtain. The brandy of our shops and taverns is not only systematically 'lowered' a little (with spirit of wine or British brandy) by the wholesale dealer, but it undergoes a like process, but to a much greater extent, at the hands of the retailer. The only method to obtain perfectly pure brandy is either to take it direct from the bond store, or to buy it of some respectable dealer, and to pay a proper price. When this cannot be done, British brandy should be purchased, by which money will be saved, and a more wholesome article obtained.

French brandy, as already noticed, is commonly 'lowered' with water, malt brandy, and spirit of wine, by which its original flavour is more or less weakened and injured. This species of adulteration is best detected by the palate. Another, and no very uncommon fraud practised by the retailers, is to reduce their brandy with a large quantity of water. As a natural consequence their liquor suffers so greatly in flavour, and its deficiency in alcohol becomes so apparent that they soon see the necessity of either abandoning the nefarious practice, or resorting to others of a less harmless character to disguise it. The latter alternative is commonly adopted. An excess of burnt sugar is immediately introduced into the spirit, followed by sundry portions of cayenne pepper, grains of paradise, horse-radish, acetic ether, &c., to give it a pungency and 'make-believe strength.' This fraud may be detected by gently evaporating a little of the suspected liquor in a spoon or glass capsule, when the acrid matter, colouring, and sugar will be left behind, and may readily be detected by their flavour, sweetness, glutinosity, &c. A little perfectly pure brandy evaporated in a similar manner (on a watch-glass, for instance), merely leaves a trifling discoloration on the surface of the glass. Genuine French brandy always reddens blue litmus paper, from containing a little acetic acid; the old coloured varieties are also blackened by a solution of a persalt of iron. Another test for caramel (burnt sugar) is to shake a small quantity of the brandy with 1-6th of its volume of white of egg, and allow the precipitate formed to deposit, or remove it by filtration; the clear liquid ought to be colourless. Should caramel be present, however, it will retain its colour. Sometimes brandy is contaminated with a small quantity of lead or copper derived from the apparatus or utensils with which it has been prepared or measured. The presence of these substances may be detected as follows:

1. COPPER: *a.* A small piece of clean polished iron or steel immersed in the suspected liquid for a short time (with agitation) becomes coated with a film of metallic copper, when that metal is present. The sample should be slightly acidulated with a few drops of pure acetic acid.

b. (*Böttger.*) A little of the brandy is to be agitated with a few drops of pure olive oil. The latter will acquire a green colour if copper be present.

2. LEAD. *a.* Hydrosulphuric acid and sulphide of ammonia produce a black precipitate or discoloration in brandy containing lead. *b.* Sulphuric acid gives a white precipitate which is blackened by ammonium sulphide.

3. Methylated spirit is detected by rubbing a little of the suspected brandy on the hands, and then drawing a long breath with the hands over the mouth. The peculiar odour of the methylated spirit, if present, then becomes evident. This test requires practice and experience.

4. TO DETERMINE THE ALCOHOLIC STRENGTH. Put 100 c.c. of the brandy into a small retort, or into a flask, with a lateral tube, and distil to dryness, or nearly so, condensing the distillate by means of a suitable receiver, and estimate the alcohol as detailed under ALCOHOLOMETRY. The brandy may be roughly tested for fusel oil by burning a little of it in a dish, and depressing over the flame a saucer or other cold piece of porcelain. If a black stain is left, some of the lower alcohols are very probably present, and should be looked for by distilling half a pint of the spirit, and examining the lateror heavier products. The vinic alcohol being the most volatile comes over first, the heavier fusel oil remaining until the later stages.

Concluding Remarks. In the 'trade,' the addition of water ('liquor') to spirit is technically called 'reducing;' whilst absolute adulteration is known under the questionable name 'improving.'

Formulæ for 'reducing' brandy:

1. Cognac brandy (10 u. p.), 20 galls.; British brandy (17 u. p.), 5 galls.; water, 4½ galls. Strength of mixture, 25 u. p.

2. To 72 galls. of full-flavoured French brandy

(5 u. p.) are added 10 galls. of spirit of wine (58 o. p.); 25 galls. of water, and 1 pint of good colouring. The whole is then well 'rummaged up,' and allowed to stand for two days, when it is fit for use. Strength of mixture, 22 u. p.

A liqueur, sold in London under the name of 'brandy improver,' or 'brandy essence,' consists of a thin sugar syrup, flavoured with acetic ether and essence of cayenne, and coloured with burnt sugar. It is said to heighten the true Cognac flavour, and restore lost alcoholic strength.

Brandy, British. *Syn.* MALT BRANDY, &c. For a long time this liquor was distilled from spoiled wine and the dregs of wine, both British and foreign, mixed with beer-bottoms, spoiled raisins, and similar substances. Pure malt spirit is the most convenient, if not the best basis of an imitation brandy.

Prep. 1. To 12 galls. of malt spirit (finest and flavourless) at proof, add, of water, 5 galls.; crude red tartar or wine-stone, $\frac{3}{4}$ lb. (previously dissolved in 1 gall. of boiling water); acetic ether, 6 fl. oz.; French wine-vinegar, 2 quarts; French plums (bruised), 5 lbs.; sherry wine-bottoms, $\frac{1}{2}$ gall.; mix in a sherry or French-brandy cask, and let them stand for about a month, frequently 'rummaging up' the liquor with a stick; next draw over 15 galls. of the mixture from a still furnished with an agitator. Put the 'rectified spirit' into a clean, fresh-emptied Cognac-brandy cask, and add of tinture of catechu, 1 pint; oak shavings, 1 lb.; and spirit-colouring, $\frac{1}{2}$ pint; agitate occasionally for a few days, and then let it repose for a week, when it will be fit for use. *Prod.*, 15 galls. of BRANDY, 17 u. p. Age greatly improves it.

2. Malt spirit (as before), 99 galls.; red tartar (dissolved), 7 lbs.; acetic ether, $\frac{1}{2}$ gall.; wine-vinegar, 5 galls.; bruised raisins or French plums, 14 lbs.; bitter-almond cake (bruised and steeped for 24 hours in twice its weight of water, which must be used with it), $\frac{1}{4}$ lb.; water, q. s.; macerate as before, and draw over, with a quick fire, 120 galls. To the distilled spirit add a few lbs. of oak shavings; 2 lbs. of powdered catechu (made into a paste with hot water), and spirit-colouring, q. s.; and 'finish' as in the last. *Prod.*, 120 galls. of spirit, fully 17 u. p. Equal in quality to the last.

3. Clean spirit (17 u. p.), 100 galls.; nitrous ether, 2 quarts; cassia buds (ground), 4 oz.; bitter-almond meal, 5 oz.; orris-root (sliced), 6 oz.; powdered cloves, 1 oz.; capsicum, $1\frac{1}{2}$ oz.; good vinegar, 3 galls.; brandy-colouring, 3 pints; powdered catechu, 2 lbs.; full-flavoured Jamaica rum, 2 galls. Mix in an empty Cognac 'piece,' and macerate for a fortnight, with occasional stirring. *Prod.*, 106 galls., at 21 or 22 u. p.

4. Malt spirit (17 u. p.), 100 galls.; catechu, 2 lbs.; tincture of vanilla, $\frac{1}{2}$ pint; burnt-sugar colouring, 1 quart; good rum, 3 galls.; acetic or nitrous ether, 2 quarts. Mix as the last.

5. Clean spirit (17 u. p.), 89 galls.; high-flavoured Cognac, 10 galls.; oil of cassia, 2 dr.; oil of bitter almonds, 3 dr.; powdered catechu, 1 lb.; cream of tartar (dissolved), $1\frac{1}{4}$ lbs.; Beaufoy's concentrated acetic acid, $\frac{1}{2}$ gall.; sugar colouring, 2 or 3 pints; good rum, 1 gall. When the above mixtures are distilled, the French brandy, colouring, and catechu, should be added to the distilled spirit.

6. To plain spirit (coloured), at 17 u. p., add a little tincture of catechu, and a sufficient quantity of eau-de-vie de marc, or of the oil distilled from wine-lees, to flavour it.

Obs. The oil referred to in the last formula is obtained by distillation from the lees of wine, either dried and made up into cakes, or in their wet state, mixed with about 7 or 8 times their weight of water. This oil should be kept dissolved in alcohol, as it is otherwise apt to lose its flavour. Brandy from any part of the world may be very closely imitated by distilling the oil from the lees of the wines produced in that particular district. Where black tea is cheap, as in the United States of America, it is very commonly employed to impart the roughness of brandy to the coloured spirit, and the subsequent addition of a little 'flavouring' greatly improves it. A really good article of cider-spirit thus treated forms a passable 'mock brandy.' In conclusion, we may remark that, as the strength and quality of ingredients frequently vary, and success depends greatly on skill in manipulation, much must be left to the experience, judgment, and discretion of the operator. In all cases he must recollect that a certain degree of 'age' is absolutely necessary to give a high character to any spirit. Indeed, to age in the one case, and its absence in the other, may be referred the reasons why French brandy and British brandy, apart from mere shades of flavour, so materially differ.

Brandy, Caraway. A species of cordial commonly prepared as follows: 1. Caraway seeds (bruised), 4 oz.; lump sugar, 2 lbs.; British brandy, 1 gall.; macerate a fortnight, occasionally shaking the bottle. 2. Sugar, 1 lb.; caraways (bruised), 1 oz.; 3 bitter almonds (grated); spirit-colouring, 1 oz.; plain spirit of gin (22 u. p.), $\frac{1}{2}$ gall.; as before. Some persons omit the colouring.

Brandy, Cher′ry. *Prep.* 1. Brandy and cherries (crushed), of each 1 gall.; let them lie together for 3 days, then express the liquor, and add 2 lbs. of lump sugar; in a week or two decant the the clear portion for use.

2. To the last add 1 quart of raspberry juice, and $\frac{1}{2}$ pint of orange-flower water. Both the above are excellent.

3. Treacle, 1 cwt.; spirit (45 u. p.), 41 galls.; bitter almonds (bruised), 1 lb. (or more or less to taste); cloves, 1 oz.; cassia, 2 oz.; macerate a month, frequently stirring. This is the article now commonly vended in the shops and at stalls for cherry brandy.

4. German cherry juice, 15 galls.; pure rect. spirits, 20 galls.; syrup, 5 galls.; oil of bitter almonds, 1 dr.

Obs. Equal part of fully ripe Morella cherries and black cherries produce the richest cordial. Some persons prick each cherry separately with a needle instead of crushing them; in which they retain them in the liquor, and serve up a few of them in each glass. The plan named in the first formula is, however, that usually adopted. On the small scale, the fruit is commonly bruised between the fingers. A portion only (if any) of the stones in the cherries should be crushed, to import a nutty flavour. See LIQUEURS.

Brandy, Ci'der. From cider and perry; also from the marc of apples and pears fermented. It is very largely manufactured in the United States of America and Canada, where it may be purchased for about 2*s.* 1*d.* a gallon. See BRITISH BRANDY (*above*).

Brandy, Dant'zic. From rye, ground with the root of *Calamus aromaticus.* It has mixed flavour of orris and cinnamon.

Brandy, Guern'sey. Beet-root spirit flavoured.

Brandy, Lem'on. *Prep.* 1. French lemons (sliced), 1 doz.; brandy, 1 gall.; macerate for a week, press out the liquor, and add a lump of sugar, 1 lb.

2. Proof spirit, 7 galls.; essence of lemon, 3 dr.; sugar, 5 lbs.; tartaric acid, 1 oz.; (dissolved in) water, 2 galls.; turmeric powder or spirit-colouring, a dessert-spoonful; as before. Sometimes milk is added to the above, in the proportion of 1 quart (boiling hot) to every gallon.

Brandy, Malt. See BRITISH BRANDY

Brandy, Or'ange. As lemon brandy, but employing oranges.

Brandy, Pale. A spurious article is often met with, made by mixing together about equal parts of good brown French brandy, clean spirit of wine, and soft water, and allowing the whole to stand until the next day to 'fine down.' If the first is 9 u. p., and the second 58 o. p., the product will be 17 u. p. Deficiency of strength is made up by adding more spirit of wine.

Brandy, Peach. From peaches, by fermentation and distillation. Much used in the United States, where peaches are very plentiful, and consequently cheap. A cordial spirit under the same name is prepared as follows:

1. From peaches, sliced and steeped in twice their weight of British brandy or malt-spirit, as in making cherry brandy.

2. Bitter almonds (bruised), 3 oz.; proof spirit (pale), 10 galls.; water, 3 galls.; sugar, 5 or 6 lbs.; orange-flower water, ½ a pint; macerate for 14 days. Add brandy-colouring, if required darker.

Brandy, Rais'in. (rā'zn). See SPIRIT (Raisin).

Brandy, Rasp'berry (răz'-). From raspberries as directed under CHERRY BRANDY. Sometimes a little cinnamon and cloves are added. The only addition, however, that really improves the flavour or bouquet is a little orange-flower water, or a very little essence of vanilla.

Brandy, White. See *antè.*

BRASS. *Syn.* ÆS, Æ''RIS METAL'LUM, L.; AIRAIN, LAITON, CUIVRE JAUNE, Fr.; ERZ, MESSING, Ger.; BRÆS, Sax. An alloy of copper and zinc.

Prep. Brass is prepared by fusing together copper and zinc, either in crucibles or on the hearth of a furnace. In the former case the crucible is first charged with a layer of brass-waste mixed with powdered charcoal, the mixture of copper and zinc in suitable proportions is then added, and the whole is covered with a layer of brass-waste and pulverised charcoal. In the latter case copper is melted on the hearth of the furnace, and zinc and brass-waste, previously heated nearly to their melting points, are added; by this means a fluid homogeneous alloy is obtained. The brass is then cast into ingots in the same manner as pig-iron, or into plates, by pouring into moulds made of loam, or of granite coated with clay. Plate-brass is generally rolled into sheets; but, as this process makes it very brittle, it is annealed between each passage through the rollers. The finished sheets are black, and in order to give them the characteristic yellow colour of brass they are cleansed by the process termed *pickling* or *dipping,* which consists of immersing them first into a bath of dilute sulphuric acid, and then into dilute nitric acid.

As the proportion of zinc in the alloy increases, the colour changes from copper colour to red-yellow and yellow; but when there is more than 30% of zinc present the red colour reappears and remains up to 50% of zinc, after which it decreases rapidly, the alloys with 53%, 56% and 64% of zinc being respectively reddish-white, yellowish-white, and bluish-white; with a still higher content of zinc the alloy acquires a leaden colour.

Alloys containing up to 35% of zinc can only be converted into wire or sheet in the cold, those with from 15% to 20% being the most ductile. Alloys with from 36% to 40% of zinc can be worked cold as well as hot. With a still higher percentage the ductility decreases rapidly; and an alloy with, for instance, from 60% to 70% of zinc is so brittle that it cannot be worked. If, however, the content of zinc is increased up to a maximum (70% to 90%), the ductility increases again, and the alloy can be worked quite well when heated (but not at a red heat).

The tenacity of brass also varies with the composition, being greatest in the case of the alloy containing 28·5% of zinc.

The following table gives the percentage composition of various samples of brass:

Lead is added to cast brass which has to be turned or worked, because it prevents the metal from fouling the tools in working it.

English stereo-metal (*Gedge's alloy for sheathing for vessels*). Copper, 60 parts; zinc, 38·1; iron, 1·5. This alloy has very great strength, standing a greater pressure than wrought iron, and equal even to the best steel; hence it is sometimes used for the cylinders of hydraulic presses.

RED BRASS contains 80% and upwards of copper, and is used for gilding and in the manufacture of sham jewellery; important varieties are:

1. (*Tombac.*) Copper, 84 to 85 parts; zinc, 16 to 15 parts; sometimes a little lead is added, and occasionally, in articles used for gilding, the proportion of copper is very great, even in one case as much as 98%.

2. (*Pinchbeck.*) Copper, 88·8 to 93·6 parts; zinc, 11·2 to 6·4 parts.

For further information see ALLOYS, COPPER, MOSAIC GOLD, PRINCE'S METAL, TOMBAC.

Anal. A piece of the alloy, say 5 grms., is dissolved in nitric acid with the aid of heat.

a. After the action has ceased water is added, and the solution is filtered off from the white insoluble residue of peroxide of tin. This is washed, dried, ignited, and weighed; its weight multiplied by 0·786 gives the amount of TIN in the piece of alloy taken.

Brass.	Place of Manufacture.	Copper.	Zinc.	Lead.	Tin.
Sheet	Jemappes	64·6	33·7	1·4	0·2
„	Stolberg	64·8	32·8	2·0	0·4
„	Romilly	70·1	29·3	0·4	0·2
„	Rosthorn (Vienna)	68·1	31·9	—	—
„	„ „	71·5	28·5	—	—
„	„ „	71·1	27·6	1·3	—
„	Iserlohn and Romilly	70·1	29·9	—	—
„	Ludenscheid	72·7	27·3	—	—
„	(*Brittle*)	63·7	33·0	2·5	—
„	Hegermühl	70·2	27·5	0·8	0·2
„	Oker	69·0	29·5	1·0	—
Wire	England	70·3	29·3	0·3	0·2
„	Augsburg	71·9	27·6	0·8	—
„	Neustadt	70·2	27·5	0·2	0·8
„	„	71·4	28·2	—	—
„	(*Good quality*)	65·4	34·6	—	—
„	(*Brittle*)	65·5	32·4	2·1	—
„	(*For wire and sheet*)	67·0	32·0	0·5	0·5

Cast Brass—Variety.	Copper.	Zinc.	Iron.	Lead.	Tin.
Cast brass from Oker	71·9	24·4	2·3	1·1	—
„ „	62·2	37·3	0·1	0·6	—
Black Forest clock wheels	60·7	36·9	0·7	—	1·3
„ „	66·1	31·5	1·4	0·9	—
Cast brass from Iserlohn	63·7	33·5	—	0·3	2·5
„ „	64·5	32·4	—	2·9	0·2
French yellow brass (*Potin jaune*)	71·9	24·9	—	2·0	1·2
English sterling metal	66·2	33·1	0·7	2·0	—
„ „	66·7	26·7	0·7	—	—

b. To the filtered nitric acid solution sulphuric acid is added as long as a white precipitate (of lead sulphate) falls; the solution is allowed to stand for several hours, and is then filtered off from the lead sulphate, which is washed, first with dilute sulphuric acid and then with dilute alcohol, ignited in a porcelain crucible, and weighed. Its weight multiplied by 0·683 gives the amount of LEAD in the alloy.

c. Sulphuretted hydrogen is passed through the filtered solution obtained in *b*, and the liquid is filtered off from the black precipitate of copper sulphide; this latter is washed with water containing a little sulphuretted hydrogen, and is then digested with nitric acid till the sulphur which separates out has acquired a full yellow colour. The resulting solution is fitered off from the sulphur, diluted with water and boiled; a solution of potash is then added in slight excess, and the boiling continued till the precipitated copper oxide becomes a dark brown or black; this precipitate is then collected on a filter, washed with boiling water till free of alkalies, dried, ignited, and weighed directly it has cooled; its weight multiplied by 0·798 gives the amount of COPPER in the alloy.

d. The solution filtered from the copper sulphide in *c* is boiled, a solution of sodium carbonate is added in slight excess, and the boiling continued for a few minutes. The white precipitate of carbonate of zinc is collected on a filter, washed, dried, and converted by ignition into the oxide, in which state it is weighed. The weight of the oxide multiplied by 0·802 gives the amount of ZINC in the alloy.

Brass, to Clean. Mix common nitric acid, 2 parts, and 1 part of strong sulphuric acid in a stone jar, and have ready a pail of water and a box of sawdust. Dip the brass articles in the acid, then in the water, and then rub well with the sawdust. If greasy, dip in strong soda for a moment, and wash and dry before using the acid bath.

BRASS BATH (FOR ELECTRO-PLATING). *For steel, wrought and cast iron, and tin; using ordinary cyanide of potassium.* Dissolve together in 14 pints of distilled or rain water: Bisulphite of soda, 7 *oz.*; cyanide of potassium (containing 75% of real cyanide), 17 *oz.*; carbonate of soda, 34 *oz.* To this solution add the following, made up to 3¼ pints of water: Acetate of copper, 4½ *oz.*; neutral protochloride of zinc, 3½ *oz*; the two liquors become colourless when mixed. Ammonia must not be used for brass electro-plating baths for iron, especially for solutions worked in the cold.

Brass Bath. *Modification for zinc.* Pure or rain water, 4½ galls.; bisulphite of soda, 24½ *oz.*; cyanide of potassium (containing 75% of cyanide, 35 *oz.* To this add the following solution: Water, 9 pints; acetate of copper and protochloride of zinc, each, 12½ *oz.*; liquid ammonia, 14 *oz.*

The filtered bath is colourless, and gives, under the action of the battery, a brass deposit of a very fine shade, varying from red to green by increasing the proportion of copper or that of zinc.

BRASS COLOUR. *Syn.* BRASS-PIGMENT, B.-BRONZE. *Prep.* 1. Grind copper filings, or the precipitated powder of copper, with a little red ochre. Red-coloured.

2. Gold-coloured brass, or Dutch leaf reduced to a very fine powder. Yellow or gold coloured.

Obs. Before application these powders are mixed up with pale varnish, no more being worked up at once than is wanted for immediate use. They are also applied by dusting them over any surface previously covered with varnish to make them adhere.

BRASSFOUNDERS' AGUE. A disease not uncommon among brass-workers; the result of the constant inhalation of particles of brass. Irritant poisoning, and in no way related to true ague or malaria.

BRASSICA CAMPESTRIS, Linn. Sub-sp. *rapa*, Linn. The COMMON TURNIP. A hardy biennial found in corn-fields and similar places in this country. The root, which is succulent under cultivation, is hard and woody in its wild state.

BRASSICA OLERACEA, Linn. A variety of the garden cabbage, the stems of which are made into walking-sticks.

BRASSICON. A compound much used in the province of Kiew (Russia) as a remedy against headache. Oil of pepperment, 30 drops; oil of mustard, volatile, 6 drops; camphor, 10 gr.; ether, 60 gr.; alcohol, 180 gr.; tincture of peppermint or melissa, enough to impart colour.

BRASS'ING. *Syn.* BRASS-COATING. 1. Copper-plates and copper-rods may be covered with a superficial coating of brass by simply exposing them, in a heated state, to the fumes given off by melted zinc at a high temperature. The coated plates and rods are rolled into thin sheets or drawn into wire. The spurious gold wire of Lyons is said to be made in this way.

2. Vessels of copper may be coated with brass, internally, by filling them with water strongly soured with hydrochloric acid, adding some amalgam of zinc and cream of tartar, and then boiling the whole for a short time. This plan may be usefully applied in certain cases to copper boilers in laboratories, and to other purposes.

3. By the electrotype (which *see*).

BRASS PASTE. *Prep.* 1. Soft soap, 2 oz.; rotten-stone, 4 oz.; beaten to a paste.

2. Rotten-stone made into a paste with sweet oil.

3. Rotten-stone, 4 oz.; oxalic acid (in fine powder), 1 oz.; sweet oil, $1\frac{1}{2}$ oz.: turpentine, q. s. to make a paste.

Obs. The above are used to clean brass-work, when neither varnished nor lacquered. The first and last are best applied with a little water; the second with a little spirit of turpentine or sweet oil. Both require friction with soft leather. See BRASS-WORK, PASTES, &c.

BRASS PLATING. *By simple dipping.* A colour resembling brass is given to small articles of iron or steel by a long stirring in a suspended tub containing the following solution: Water, 1 quart; sulphate of copper and protochloride of tin crystallised, about 1-5th of an *oz.* each. The shades are modified by varying the proportions of the two salts.

BRASS-STAIN. *Prep.* 1. Sheet-brass (cut into small pieces) is exposed to a strong heat for 2 or 3 days, then powdered, and again further exposed in a like manner for several days; the whole is then reduced to fine powder, and exposed, a third time, to heat, testing it occasionally, to see if it be sufficiently burnt. When a little of it, fused with glass, makes the latter swell and froth up, the process is complete. It imparts to glass a green tint, passing into turquoise.

2. Equal parts of plate-brass and sulphur are stratified together in a crucible, and calcined, until they become friable; the whole is then reduced to powder and exposed to heat as before. This imparts a calcedony red or yellow tinge to glass by fusion; the precise shade of colour being modified by the mode of using it.

Obs. The common practice in the glass-houses is to conduct the calcination by exposing the metals, placed on tiles, in the leer or annealing arch of the furnace,—a plan both convenient and economical.

BRASS'-WORK. Articles of brass and copper, when not varnished or lacquered, may be cleaned and polished with sweet oil and tripoli, rotten-stone, or powdered bath-brick, applied with friction on flannel, and 'finished off' with leather; due care being taken to ensure the absence of anything gritty, which would scratch and disfigure the surface of the metal. A strong solution of oxalic acid in water gives brass a fine colour. Vitriol and spirits of salts make brass and copper very bright, but the polish thus obtained soon tarnishes, and the articles consequently require more frequent cleaning. A strong lye of roche alum and water also improves the appearance of brass. In all cases where acids or saline matter has been used, the metal should be at once well rinsed in clean water, and then wiped dry, and finally dry polished with soft leather.

BRASS INLAID-WORK may be cleaned with tripoli and linseed oil, applied by a rubber of felt or leather; the whole being afterwards thoroughly rubbed off, and then finished with clean soft leather. The ornaments of a French clock, and similar articles, are said to be best cleaned with bread-crumb, carefully rubbed, so as not to injure the wood-work. ORMOLU CANDLESTICKS, LAMPS, and BRANCHES, may be cleaned with soap and water. LACQUERED and GILDED ARTICLES are spoiled by frequent rubbing, and by acids and alkaline leys.

1. A fine colour may be given to BRASS ORNAMENTS, when not gilt or lacquered, with a little sal-ammoniac, in fine powder, moistened with soft water. The articles must be afterwards rubbed dry with bran and whiting. Another plan is to wash the brass-work with a strong lye of roche alum (1 oz. to water 1 pint), and after rinsing in clean water and drying it, to finish it off with fine tripoli. These processes give to brass the brilliancy of gold. See BRASS PASTE.

2. A gold varnish for giving a beautiful gilding to brass and bronze objects is prepared from 16 grms. of shellac, 4 grms. of dragon's blood, 1 grm. of turmeric-root, and 332 grms. of rectified spirit of wine. The varnish is thinly stroked over the surface with a sponge, the metal being warmed over a small coal fire.

The surface at first appears dull, but soon after it appears as if most beautifully gilded. The ready-prepared spirituous varnish must be preserved in well-stoppered vessels ('Dingler's Journal').

BRAUNETINCTUR—QUINSY OR BROWN TINCTURE (*Netsch*, Rauschau), an embrocation for the larynx, is a mixture of 3 parts oil of cloves and 1 part creosote (*Hager*). According to Leimbach, 1 part creosote with 3 parts of a spirituous tincture of cochineal perfumed with oil of cloves.

BRAWN. A boar or its flesh. When young,

the horny parts feel moderately tender. If the rind is hard, it is old (*Mrs Rundell*). Also, in *cookery*, the flesh of the boar, or of swine, collared so as to squeeze out as much of the fat as possible, boiled, and pickled.

Brawn, Mock. *Prep.* (*Mrs Rundell.*) Take the head and belly-piece of a young porker, well saltpetred; split the head and boil it; take out the bones and cut it to pieces; then take 4 ox-feet, boiled tender, and cut them in thin pieces; lay them in the belly-piece with the head, cut small; roll it up tight with sheet tin, and boil it 4 or 5 hours. When it comes out set it up on one end, put a trencher on it (within the tin), press it down with a heavy weight, and let it stand all night. The next morning take it out of the tin and bind it with a fillet, put it in cold salt-and-water, and it will be fit for use; it will keep a long time if fresh salt-and-water are put into it about once every four days.

BRAXY in sheep—an anthracoid disease—is a form of septicæmia simulating *Anthrax*, but is not contagious, and has no specific germ. The first sign is a short step; then the animals lie down and get up again frequently, caused by pain in the bowels; the belly swells and the wool begins to fall, and has a dry appearance after death. The body, when opened, presents the appearance of general congestion; the flesh is dark red, and the serous membranes and subcutaneous tissues often contain patches of hæmorrhage; the bowels are inflamed and bloody, and distended with foul-smelling gas.

Braxy is a disease affecting young sheep on wet soils; it is a very fatal malady, and treatment is of little avail. Chlorate of potash and turpentine have been recommended in the earlier stages, and later quinine, mineral acids, and salts and iron. Eggs and milk beaten together are said to be the best food, or beef tea. Very great care and attention is required to save the animal's life.

BRAZILETTO WOOD, the product of *Peltophorum Linnæi*, Benth., *Cæsalpina brasiliensis*, Linn. A native of Jamaica or some other of the West Indian Islands, but *not* of Brazil.

BRAZILIN, $C_{16}H_{14}O_5$. *Syn.* BRESE''LINE, SAPA'NINE. The red dye of Brazil and Sapan woods. In the free state it crystallises in colourless glancing needles (containing water of crystallisation), which are soluble in water, alcohol, and ether. It turns orange in the air. Aqueous alkalies in presence of air turn it red, the compound BRAZILEÏN, $C_{16}H_{15}O_5 . H_2O$ being formed.

BRAZIL NUTS. The particular tree yielding these nuts (the *Bartholetia excelsa*) is a native of the Amazons, whence the nuts are exported to the yearly annual amount of about 60,000 bushels. Each fruit consists of a hard globular shell, containing about 24 nuts.

When the kernels of the nuts are submitted to pressure they yield an oil in great repute for domestic purposes and for export, each pound of the nuts yielding 9 oz. of the oil, valued at 2*s.* the pound. According to Martius, this oil consists of 74% of olein, and 26% of stearin. The finely laminated inner bark of the trunks is also a valuable article of commerce, especially adapted for the caulking of ships and barges, and is worth about 18*s.* per cwt.

The following analysis by Corenwinder gives the composition of the kernels taken from the nuts when in a fresh condition:

Water		8·00
Oil		65·60
Nitrogenous matters		15·31
Non-nitrogenous organic matters		7·39
Phosphoric acid	1·35	3·70
Lime, potash, silica, &c.	2·35	
		100·00

BRAZIL WOOD. *Syn.* BRAZIL‡; LIGNUM BRAZILIENSE, L.; BOIS DE BRÉSIL, Fr. A dye-stuff, believed to be furnished by several species of trees of the genus *Cæsalpinia.* The sources of Brazil wood, Peach wood, and Lima wood are not satisfactorily known. (See RED DYES.)

BRA''ZING. The operation of uniting pieces of copper, brass, iron, &c., by means of hard solder.

Proc. The edges, after being filed or scraped quite clean, are covered with a mixture of hard solder and powdered borax, made into a paste with water. The whole is then allowed to dry, and is afterwards exposed, in a clear fire, to a heat sufficient to melt the solder. See AUTOGENOUS SOLDERING, SOLDERS, &c.

BREAD (brĕd). *Syn.* PA'NIS, L.; PAIN, Fr.; BROD, Ger.; BROOD, Dut.; BRÖD, Dan., Swed.; BREOD, Sax. Loaves or cakes made from ground corn, and constituting the staple article of food of all civilised nations. The simplest form of bread is that made by adding to the flour a small quantity of salt, mixing with the requisite quantity of water and then baking, the product constituting what is known as unleavened bread. For ordinary purposes this form of bread is now as a rule no longer used, but the oat-cakes, pea and barley bannocks of Scotland, the passover bread of the Jews, and the damper of the Australian shepherd, are all examples of unleavened bread. Bread so made is, as is well known, dense, heavy, and indigestible, and unless baked in very thin sheets is liable to all the defects incidental to imperfect cooking; nevertheless it can be so prepared as to be at least unobjectionable, and in the case of those who are leading active lives in the open, is an article of diet by no means to be despised. Leavened bread is very rarely made nowadays, as the process is troublesome and the resulting product of very uncertain and inferior quality. The leaven was made by allowing a mixture of flour and water to ferment spontaneously by the operation of such ferment-organisms as reached it from the air; these were of necessity variable both in kind and quantity, and consequently their action on the flour was uncertain and variable. A portion of this leaven was mixed with the quantity of flour which it was proposed to make into bread and the process of fermentation slowly spread through the whole mass, which was then divided into loaves and baked in the usual manner, a portion of the material being reserved to start the process in the next batch. This process is now almost entirely superseded by yeast-fermentation, or the action of a definite organism which can be obtained in a very pure

state and in almost unlimited quantity in the process of brewing, so that by the use of it bread-making, from being a more or less haphazard process, has become almost scientific. The terms heavy and light as applied to bread are so generally understood and accepted that no definition of them is required here. The object of fermentation, or of any other process which has been used to take its place, is primarily to lighten the bread and give it a firm but spongy texture, whereby it is rendered more palatable and at the same time more digestible. Fermentation effects this in a very simple manner. The yeast plant acts upon the starch of the flour converting it into sugar and carbonic acid gas, which, being set free in the substance of the dough, forms within it a number of small spaces full of gas; when the dough is baked this gas expands and the spaces are thereby enlarged, causing the mass to swell or 'rise,' as it is called. Reference will be made later to other processes by which this is effected.

In order to understand fully the principles involved in the manufacture of good bread, the composition of the materials of which it is made must be considered, and the changes which they undergo in the process, and the part played by each in bringing about the desired result.

From what has been said above regarding the action of the yeast upon the starch, it might be imagined that the process was a purely mechanical one, and that the use of the ferment was simply a convenient way of effecting the desired aëration. Such, however, is very far from being the case. Starch, though a very important constituent of flour, is by no means the most important, as the following table will show:

Average Composition of the Grain of Cereals.

	Old Wheat.	Barley.	Oats.	Rye.	Maize.	Rice.
Water	11·1	12·0	14·2	14·3	11·5	10·8
Starch	62·3	52·7	56·1	54·9	54·8	78·8
Fats	1·2	2·6	4·6	2·0	4·7	0·1
Cellulose	8·3	11·5	1·0	6·4	14·9	0·2
Gum and sugar	3·8	4·2	5·7	11·3	2·9	1·6
Albuminoids	10·9	13·2	16·0	8·8	8·9	7·2
Ash	1·6	2·8	2·2	1·8	1·6	0·9
Loss, &c.	0·8	1·0	0·2	0·5	0·7	0·4

Thus, excluding the water, we find that the starch and albuminoids together constitute the most important part of the grain of cereals, and, though it is to the fermentation of a portion of the starch that bread owes its spongy character, it is the albuminoids which enable this character to be retained, and more especially the gluten of the flour.

Gluten may be obtained from flour by placing a small quantity in a bag of fine muslin and washing the starch out by allowing water to run on to the outside of the bag from a tap, the contents of the bag being kneaded the while between the fingers. By this means the starch is to a very large extent washed out of the flour and a sticky tenacious mass left behind, which may be further freed from starch, which it still contains, by kneading under water. It is to this sticky material, gluten, that bread owes its spongy character, and which enables it to be retained after it is baked.

In the process of fermentation the starch is converted first into dextrin, and a peculiar sugar known as maltose. Heat alone will effect the change of starch into dextrin, and this is the usual manner of preparing it on a large scale for the many manufacturing purposes for which it is used. The action occurs more readily if a small amount of moisture be present; and the Paris and Vienna bakers take advantage of the change to give the outside of their loaves the delicate brown colour which is characteristic of them. This is done by injecting into the oven in which the bread is baking a certain quantity of steam which becomes superheated by the heat of the oven, and, acting on the starch on the surface of the loaves, converts it into dextrin or British gum; and in the further process of baking this layer of dextrin acquires the delicate brown tint which is more or less characteristic of foreign breads. Dextrin is a gummy body resembling in its viscosity ordinary gum arabic, and is the material used for gumming the backs of postage stamps.

Inasmuch as dextrin when exposed to such a temperature as prevails in a baker's oven turns brown, although a little on the surface is useful to give a colour to the loaf, it is obviously undesirable that large quantities should be formed, as there would be a risk of the whole loaf acquiring a brown tinge throughout, and the product would be unsaleable. The crude gluten of wheat-flour consists in reality of about four fifths fibrin and one fifth of an albuminous body called 'gluten,' which is slightly soluble in cold water, much more soluble in hot water and also in spirits of wine, *i. e.* in diluted alcohol, so that pure gluten-fibrin may be prepared by digesting crude gluten in dilute alcohol. There are two other albuminoids in wheat-flour which are soluble in water, and therefore lost in the process of preparing gluten, namely, an albumin and a body which may be called legumin (sometimes called vegetable casein, but incorrectly so). A solution of legumin in water is precipitated by acetic acid and is not precipitated on boiling, whilst the albumin is precipitated by alcohol and also by boiling its aqueous solution. There is yet another albuminoid body in wheat which is found in the bran and is confined to those layers of the grain which lie immediately underneath the husk. This body is known as 'cerealin,' is of very great importance in the manufacture of bread; for it appears to be one of those feebly constituted bodies which are capable of acting as ferments, and it undoubtedly does act in this

way upon starch, and probably plays an important part in the germination of the grain, as, in addition to this action of starch, cerealin possesses the power of converting the soluble and insoluble albuminoids into the soluble form, and thereby fits them to take a part in the life-processes of the seed. This degradation of the albuminoids from the insoluble to the soluble form takes place whenever flour is fermented in any way, so that one of the chief characteristics of a sample of unsound flour or of flour which has been made from unripe wheat, or wheat which has begun to germinate, will be readily understood; such flour always makes a dark-coloured, heavy loaf, the reason being that a large proportion of the insoluble albuminoids which are so important in the production of a light firm loaf have been degraded to the soluble condition, and are useless for the purpose. In the same way the flour of certain grains is not suitable for the manufacture of bread because there is a natural deficiency of these insoluble albuminoids. Rye, oat, and barley-flours are examples in point; the bread made from them, or rather from oat, barley, and rye-flour is dense, tough, and doughy, whilst the amount of insoluble albuminoids in oat-flour is so small that it is practically impossible to make bread from it at all by the fermentation process; whilst of all grains used for the purpose of making bread, there are none that surpass wheat in the percentage of insoluble albuminoids which they contain, so that wheat-flour is eminently suited to the purpose for which it has been applied for ages, long before anything whatever was known as to the reason why. The proportion of soluble albuminoids is also very profoundly affected by climate and harvest conditions, as also by difference of species, as the following figures will show. The ratio of insoluble to soluble albuminoids is in Flemish wheat 3·5 to 1; in Odessa wheat, 8 to 1; in Polish wheat, 11·5 to 1; in Egyptian wheat, 13 to 1; Russian, 9 to 1. The action of these soluble albuminoids upon starch is, as has been said, very important, and may be demonstrated by the following experiment:

Take two test-tubes, and into each put a small quantity of raw starch well mixed with water. Boil the starch in one of the tubes so as to burst the cells and cause the starch to pass into solution, and when cool add to both a small quantity of yeast. After a short time it will be found, on applying the proper tests, that the unboiled starch has not been acted upon in the least, but that the boiled specimen has been largely converted into sugar. Now add to the unboiled specimen a small quantity of a cold-water infusion of any of the cereals, and allow it to stand for a time. The filtered fluid will be found to give the reactions of maltose—that is to say, a something in the cold infusion of flour has acted upon the unbroken starch cells in such a way as to convert the soluble starch into dextrin and maltose. It will be readily understood from this experiment how serious may be the deterioration in quality of a sample of flour which has been allowed to become wet. We have thus a double cause for deterioration in wheats and flours, viz.: degradation of the albuminoids and conversion of the starch into dextrin and maltose; and it will be abundantly clear that for the making of good bread thoroughly ripened and well-harvested grain is of the utmost importance. For this reason foreign wheats are much superior to English for making the finer qualities of bread.

We are here brought face to face with a question which in recent years has been the subject of much acrimonious discussion, and which from the purely scientific point of view can hardly be said to admit of discussion at all, namely, the desirability of either retaining the bran, or if separated returning it to the flour, and thus using the whole grain for the making of bread instead of only the inferior portions. The question of the dietetic value of the bread thus made will be discussed under FOOD. From what has been said regarding the properties of cereals in the retention of the bran will clearly increase the difficulty of making a light well-piled loaf. This difficulty has, however, been surmounted fairly well by the use of Dr Dauglish's aëration process instead of the ordinary method of fermentation by yeast, and a very palatable bread is the result, which appears also to be appreciated by the general public. Whole meal is undoubtedly difficult of conversion into good bread by the ordinary methods, and the explanation is not far to seek when the action of the cerealin in degrading the insoluble albuminoids is considered. The following account of the method of bread-making as practised in London is given by Dr Charles Graham, in his Cantor lectures, on the 'Chemistry of Bread-making,' delivered before the Society of Arts in the winter of 1879:

"The first part of the process consists in the preparation of what is technically called 'the ferment.' I ought to say, first of all, that a sack of flour weighs 280 *lbs.*, and that a sack will turn out about 90 to 94 loaves of 4 *lbs.* each, according to the quality of the flour: so that I shall deal with a sack of flour as the unit of the operation which I shall proceed to describe. Bakers themselves, inasmuch as it is much more convenient to measure water than to weigh flour, are in the habit of speaking not so much of the flour employed as the water. The first part of the process is the preparation of the ferment. This consists in taking potatoes, about 6 *lbs.* to 8 *lbs.* to the sack (some use as much as 12 *lbs.*); and the potatoes should be, of course, well selected, and mealy—not waxy or unripe, and ill-matured. These are well washed, then boiled, in order to burst the cell-walls of the potato-starch. After they have been boiled thoroughly, they are mixed with additional water, then put into a fermenting tub, and when the temperature of the water and of the mashed potato has cooled to 85° F., the yeast is added. One quart of brewers' yeast is employed to the sack of flour, and, in addition to this, a pound or two of flour is added to supply albuminous food to the yeast. This constitutes the 'ferment.' Fermentation commences, the soluble starch is affected partly by the direct action of the yeast and partly by the action set up by the yeast ferment on the soluble albuminoids of the flour which has been added, and the result is the hydration of the starch, and the conversion of the starch into sugars and dextrin. This process goes

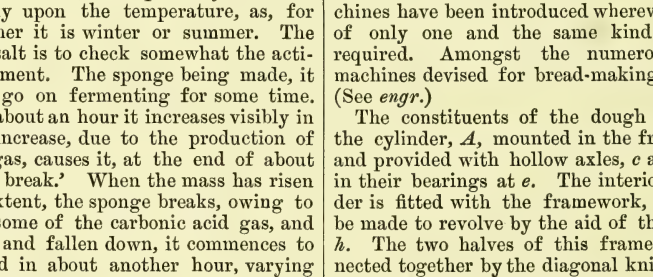
on for some five hours; it rises during that time: and at about the end of five hours, varying a little with the temperature, the head falls in. The head having fallen in, it is allowed to remain in a quiescent condition for two or three hours, and then the baker proceeds to the next stage, which is the preparation of the 'sponge.' They call it 'stirring the sponge.' In the preparation of the sponge, about one fourth of the total flour—or one third, according to the practice of those bakers who prefer a stiffer sponge—is taken. This is placed in the trough, and the 'ferment' is added, along with some more water at 85° F.; the whole of the ferment being forced through a sieve to remove the skins of the potatoes used, and thus the skins do not come in contact with the sponge. The potato-skins and the flour in the sieve are well washed by the water here added, the total amount of water used in the ferment and sponge stages being about half of the whole amount used for the sack of flour. This amount is about 60 quarts, varying somewhat with the character of the flour. Thus, up to and including the 'sponge,' one fourth—or one third according to some bakers—of the flour and some 30 to 32 quarts of water have been used. In the preparation of the sponge some bakers—not many, but still some who hold a prominent position in the trade—add a part of the salt; I have been told about one-half of the total salt, but probably this will depend entirely upon the temperature, as, for example, whether it is winter or summer. The object of this salt is to check somewhat the activity of the ferment. The sponge being made, it is allowed to go on fermenting for some time. At the end of about an hour it increases visibly in size, and this increase, due to the production of carbonic acid gas, causes it, at the end of about five hours, to 'break.' When the mass has risen to its fullest extent, the sponge breaks, owing to the escape of some of the carbonic acid gas, and having broken and fallen down, it commences to rise again, and in about another hour, varying somewhat according to the temperature at the time, or of the room, the sponge rises again and breaks again. This is called the second break. So soon as it has broken a second time, the remaining part of the flour—which would be about three fourths, or two thirds, according to the practice followed by the baker—and the remainder of the water are added.

"We pass thus to the dough. The remainder of the flour having been added, and the remainder of the water, the whole is thoroughly well mixed, and it is at this stage that most bakers add the whole of the salt. Other bakers only use that which remains over after having employed a little at the sponge stage. The total quantity of salt used I find to be about 3 *lbs.* to the sack, or 48 *oz.*, which would give about ½ *oz.* of salt to the 4-*lb.* loaf of bread.

"The dough having been thoroughly well worked (either by hand or machinery) is now left for one hour, in order to rise again. It is then scaled—that is, it is cut up into loaves. By the time a large batch of bread has been scaled and made up, of course, the previous portions are ready for the oven. They are then put into the oven, and are there heated for about an hour and a half; the temperature of the oven at the time of the introduction of the bread varying from about 400°—450° F. Of course, that is not the temperature of the bread, because the bread contains water; and, therefore, it rises little, if at all, above the ordinary temperature of boiling water."

The kneading of the dough by hand is not only a very laborious process, but it is unhealthy, and additionally objectionable on account of its being uncleanly. Added to this, the uniform quality of the dough is not to be depended upon. Although it is impossible to perform by machinery any labour which absolutely requires the touch of the human hand, bread-kneading machines have been introduced wherever the making of only one and the same kind of bread is required. Amongst the numerous kinds of machines devised for bread-making, is Clayton's. (See *engr.*)

The constituents of the dough are placed in the cylinder, *A*, mounted in the framework, *b b*, and provided with hollow axles, *c* and *d*, turning in their bearings at *e*. The interior of the cylinder is fitted with the framework, *f*, which may be made to revolve by the aid of the axles, *g* and *h*. The two halves of this framework are connected together by the diagonal knives, *i i*, which, when the machinery revolves, work up the dough; the trough or outer cylinder revolves in the opposite direction to the revolution of the framework. The crank, *o*, is connected with the axle of the trough or outer cylinder, the crank, *p*, with that of the inner framework; as the two cranks are turned in opposite directions, they impart opposite movements to trough and framework. The revolving of the machinery may be performed by one man by the aid of one crank, since the axle, *h*, of the crank, *o*, which is



fitted to the inner frame by means of the hollow axle-tree, and revolves along with it, carries a conically-shaped wheel, *m*, fitted to the wheel, *k*, which, when connected with *l*, causes the trough also to revolve; when, therefore, the wheel, *m*, turns towards the right, the wheel, *l*, will revolve towards the left. Another kneading machine is that of Mr Stevens. It is employed at the Holborn Union, where more than 5000 *lbs.* of bread are made every week by one man and two boys.

Many forms of kneading machinery are in use, but the principle involved in the construction of all is much the same as the one described.

The preparation of bread may thus be divided into definite stages or processes, each having a well-defined object.

1. *The Preparation of the Ferment.* The use of the potato in this stage is not, as is sometimes supposed, for the purpose of adulteration, but in order to obtain a rapid growth of the yeast organism. The cells of potato-starch are comparatively large, and by the rupture of one of them a relatively large amount of soluble starch is set free to be acted upon by the yeast and converted into dextrin and sugar, the albuminoids of the flour added assisting materially in the formation of these products.

2. *The Preparation of the Sponge.* This may be said to be the active stage, the process of fermentation proceeding very rapidly, and the evolution of gas swelling out and lightening the whole mass.

3. *The Dough Stage.* In this the activity of the fermentation is checked by the addition of the remainder of the flour and water and of the salt. There is no further degradation of albuminoids, no more starch is broken up, and the remainder of the action is confined to the dextrins and sugars already formed.

The manufacture of bread on a commercial scale is a process requiring great skill and judgment on the part of those who have to direct it, the choice of suitable flours and the judicious mixing of them in order to obtain a certain uniformity of quality being a most important factor in the production of good bread of constant quality. Nor does the necessity for careful supervision end with the choice of material. From what has been said it will be clear that it may often be necessary to modify some portion of the processes in order to obtain the best results from a given sample of flour.

Lastly, by the careful application of the principles laid down, the baker is enabled to make the best of an otherwise unsatisfactory sample, and to turn out good wholesome bread from flours which, if handled by the mere rule-of-thumb method, would certainly yield a heavy, undigestible, and unsaleable article.

Adult. The adulteration of both flour and bread is carried to a great extent, more especially in London. The bakers' flour is very often made of the worst kinds of damaged foreign wheat; and other cereal grains, and particularly beans, are mixed with them in grinding them into flour. In this capital no fewer than six distinct kinds of wheaten flour are brought into the market—fine flour, seconds, middlings, fine middlings, coarse middlings, and twenty-penny flour.

Among the principal substances which have been proved to have been used to adulterate wheat-flour and bread are the following:

**Alum.	*Magnesia (Carbonate).
*Ammonia (Sesquicarbonate).	*Plaster of Paris.
**Beans.	*Potash (Carbonate and bicarbonate).
*Bone-dust.	**Potatoes.
*Chalk.	**Rice.
Clay.	**Soda (Carbonate and sesquicarbonate).
Copper (Sulphate).	*Starch (Potato).
Lime (Sulphate from the soda-water makers).	**Water (in excess).
	Zinc (Sulphate).

Of these substances, those marked thus (*) are very frequently used; and those marked thus (**) almost universally so.

In the absence of chemical analysis the unalumed loaf may be roughly distinguished from the alumed one by the following characteristics: it is neither so white, so bulky, nor so symmetrical; it bites shorter, and it is free from the sour taste which accompanies the presence of alum. Again, unalumed bread a day or two old will be found to crumble with great readiness; alumed bread, however old, crumbles, on the contrary, with difficulty.

According to Mr Accum, the smallest quantity of alum that can be employed with effect to produce white, light, and porous bread, from the inferior kinds of flour commonly used by the bakers, is from 3 *oz.* to 4 *oz.* to a sack of flour weighing 280 *lbs.* But Dr P. Markham states that the ordinary bread of the London baker is made of 1 sack or 5 bushels of flour; 8 *oz.* of alum, 4 *lbs.* of salt, ½ gall. of yeast, and about 3 galls. of water. Our own analyses, extending to many hundred samples of London bread, as well as those of other chemists, show that even this large quantity of alum is often very much exceeded by the bakers (*Tuson*).

Alkaline substances, as the carbonates of ammonia, soda, and potash, are often employed to realise the important consideration of producing light and porous bread from spoiled, or, as it is technically called, sour flour. The first salt becomes temporarily converted into a gaseous state during the operation of baking, causing the dough to swell up in minute bubbles, which thus render it light and porous; the salt itself being at the same time, for the most part, volatilised. Alum is added, not only with a like intention, but also to enable the dough to carry more water. There are several instances of convictions on record of millers and bakers having used gypsum, chalk, and pipeclay in the manufacture of their goods. A gentleman, lately writing from the North of England, says that he found in one sample of flour which he recently examined upwards of 16% of gypsum; and, in another, 12% of the same earth.

A few years since it was discovered that some of the bakers in France and Belgium added blue vitriol to their dough to make it take more water, in the same way as the English baker uses alum. 1 *oz.* of this sulphate was dissolved in a quart of

water, and a wineglassful of this solution added to the water necessary to make about 50 4-*lb.* loaves. This criminal adulteration was soon detected, and deservedly caused the ruin of its perpetrators.

Exam. The following are the methods employed for the discovery of the principal sophisticants of bread, and as the chief of these, and the one most difficult of identification, is alum, we have given prominence to the processes now generally adopted for the detection of this article:

1. ALUM. *a.* (*Robine* and *Parisot.*) About ¼ *lb.* of the suspected bread (somewhat stale or dry) is reduced to crumbs, macerated for 2 or 3 hours in cold water, and then squeezed through a clean piece of white linen. The liquid is next evaporated to dryness at a steam-heat, the residuum redissolved in a little hot water, and the solution filtered. Liquor of ammonia or a solution of sal-ammoniac, and a solution of chloride of barium, added to the filtered liquid, give a white precipitate when ALUM is present.

When nearly the whole of the alum has suffered decomposition in the loaf, as is frequently the case, the following process is required:

b. (*M. Kuhlman.*) 4 or 5 *oz.* of bread are reduced to ash, which is powdered and treated with nitric acid, the mixture evaporated to dryness, and about 1 *oz.* of hot water added. A little caustic potassa is added to the last solution (unfiltered), the whole boiled a few minutes, and passed through a filter. The filtrate is next tested with a solution of sal-ammoniac, and the whole again boiled for 2 or 3 minutes. If a precipitate forms it is alumina, every 50 *gr.* of which are equivalent to 332 *gr.* of crystallised alum.

c. The suspected sample is wetted with a weak solution of logwood, or, preferably, of cochineal. Pure bread is only slightly stained by this solution; bread containing alum strikes a lavender, lilac, or purple colour, according to the quantity of the adulterant present. If it acquires a pearl-grey or bluish tint, some alkali (potash, soda, or ammonia) is present.

d. (*J. A. Wanklyn.*) 100 grms. of bread are incinerated in a platinum dish, capable of holding the whole quantity at once. The incineration is managed at a comparative low temperature, and takes some 4 or 5 hours; the platinum dish being heated by means of a large Bunsen burner, abundantly supplied with air. It is well to continue the ignition until the bread-ash is nearly completely burnt, and it is advisable to weigh the dish containing the ash. The weight of the ash should not sensibly exceed 2 grms. The ash having been obtained is then moistened with 3 c.c. of pure strong hydrochloric acid, and then some 20 to 30 c.c. of distilled water is added, and the whole is boiled, filtered, and the precipitate washed several times with boiling water. In this manner a precipitate consisting of a silica, together with some unburnt carbon, is left on the filter, whilst the filtrate contains the phosphates. The precipitate, which, after being burnt, consists of silica, is weighed. The filtrate is mixed with 5 c.c. of ammonia (sp. gr. 0·880), whereby it is rendered powerfully alkaline and opaque, owing to the precipitation of the phosphates. It is finally mixed gradually with some 20 c.c. of strong acetic acid, and as the acid is being poured in, it is to be observed that the liquid is alkaline and opaque, until some 5 c.c. of the acid have been added; that when about 10 c.c. have been added the liquid is acid and much clearer, and that at least 10 c.c. of strong acetic acid are added after the establishment of a distinctly acid reaction. The liquid is then boiled and filtered, and the precipitates, consisting of phosphates of alumina and iron, well-washed with boiling water, ignited and weighed. The last step is the determination of the iron in the weighed precipitate, and this is accomplished either by reduction and titration with standard solution of permanganate in the well-known manner, or else by a colour process, viz. by trituration with ferrocyanide of potassium. Having ascertained the amount of iron in the precipitate of mixed phosphates, it is only necessary to calculate it into phosphate of iron, and to subtract the weight of phosphate of iron from the total weight of the mixed phosphates, and the difference as the phosphate of alum yielded by 100 grms. of the bread. The following results have been obtained by applying the above-described process to samples of bread presumed to be free from alum:

From 100 *grams of Bread.*

	Bread-ash. Grams.	Silica. Grams.	Precipitate, insoluble in acetic acid. Grams.
A	1·408	—	0·010
B	1·378	—	0·006
C	1·730	0·018	0·010
D	1·620	0·032	0·014
E	—	—	0·012
(1) F	1·383	0·030	0·012
(2) F	1·324	0·025	0·014

The precipitate insoluble in acetic acid contained in every instance a large proportion of iron, but in some cases at least did not wholly consist of phosphate of iron. On deducting the quantity of phosphate of iron from the total phosphates insoluble in acetic acid, there remains a residue of some 5 or 6 milligrms. It would therefore appear that unalumed bread is liable to contain a minute trace of alumina, which, expressed as phosphate of alumina ($Al_2O_3PO_5$), equals 5 or 6 milligrms. per 100 grs. of bread, or 0·005%. If the alum corresponding to this phosphate be calculated, it will be seen that 100 grms. of unalumed bread may appear to contain 0·022 grms. of alum; or expressed on the 4-*lb.* loaf, there may appear to be 6 grms. of alum in it. This agrees very fairly with Dr Dupré's observation.

e. (*J. C. Thresh.*) The author states that this process requires only a few hours, and quotes experiments, showing the accuracy of the results:

Take 1250 gr. of bread (from middle of loaf) or flour, and char thoroughly in a platinum dish or on foil over a gas lamp. Powder the char and mix it with sufficient pure hydrochloric acid to make a thin cream. Boil gently for a few minutes, then add 100 c.c. of water, and continue the ebullition a few minutes longer. Dilute to 150

c.c., stir well, and filter off 120 c.c., which will contain the alumina from 1000 gr. of the bread or flour. To this filtrate add a slight excess of solution of ammonia, boil for a few seconds. Then let the precipitate subside, and decant the supernatant fluid. Add boiling water to the sediment, and again set aside to settle, and decant the clear fluid. Pass the fluids through a small filter to collect any particles of the precipitate which may have been suspended therein, and throw the filtrate away. Now add to the partially washed precipitate about a grm. of pure caustic potash (or soda), warm, and pass the solution through the same filter employed for the previously decanted fluids. Wash the filter with hot water, to which a little KHO may be added, and proceed to precipitate the alumina in the filtrate by adding a few drops of dilute phosphoric acid and excess of pure acetic acid. Heat the solution and precipitate to the boiling point, and then wash the latter by decantation and filtration. Finally dry, ignite, and weigh. The weight of the resulting Al_2PO_4 in grms., multiplied by 400, will give the amounts of ammonia alum in grains present in 1 *lb.* of bread or flour.

f. (*Mr. Crookes.*) The bread, of which at least 500 gr. should be taken, is first to be incinerated on a platinum or porcelain dish, until all volatile organic matter has been expelled, and a black carbonaceous ash remains. The temperature must not be raised much beyond the point necessary to effect this. Powder the coal thus obtained and add about 30 drops of oil of vitriol, and heat until vapours begin to rise; when sufficiently cool, add water, and boil for 10 minutes. Filter and evaporate the filtrate until the fumes of sulphuric acid begin to be evolved, when 10 gr. of metallic tin and an excess of nitric acid must be added, together with water, drop by drop, until action between the acid and metal commences. When all the tin is oxidised, add water, and filter. Evaporate the filtrate until fumes of sulphuric acid are again visible, when more water must be added, and the liquid again filtered if necessary. To the clear solution now add tartaric acid, then ammonia in excess, and sulphide of ammonium. Evaporate the liquid containing the precipitate suspended to it, in a dish, until all the smell of sulphide of ammonium has disappeared. Filter, evaporate to dryness, and ignite to get rid of the organic matter. Powder the black ash, boil it in moderately strong hydrochloric acid, filter, add a crystal of chlorate of potash, and boil for a minute. Now add chloride of ammonium and ammonia, and boil for 5 minutes. If at the end of that time any precipitate is observed, it will be alumina. From the filtered solution, if oxalate of ammonia be added, the lime will be precipitated; and if to the filtrate from this ammonia and phosphate of soda be added, the magnesia will come down.

Dr Dupré is of opinion that no baker should be fined in whose bread the amount of alumina found corresponds with less than 10 gr. of potash alum in the 2-*lb.* loaf, unless there is direct evidence of adulteration by alum independent of the result of analysis.

Mr Crookes says, "By treatment with a trace of alum, flour with a doubtful soundness is endowed with soundness. For this purpose a proportion of alum is required which does not exceed 20 gr. to a 4-*lb.* loaf.

2. COPPER. *a.* Moisten the suspected bread with a few drops of a solution of ferrocyanide of potassium. It will assume a pinkish-brown colour if copper be present.

b. A little of the bread may be steeped in hot water, or, better still, in water soured with a little nitric acid, and the clear liquor squeezed or poured off, and tested with ferrocyanide of potassium, as before.

3. MAGNESIA. Bread adulterated with magnesia, on digestion in hot water acidulated with sulphuric acid, furnishes a liquid which gives a white precipitate when tested with a solution of either carbonate of potassa or of carbonate of soda, especially on boiling.

4. SODA; POTASSA. Hot water after digestion on the ashes or charcoal turns turmeric paper brown. The liquid may be evaporated to dryness, redissolved in distilled water, slightly acidulated with hydrochloric acid, and tested with bichloride of platinum. If a yellow crystalline precipitate forms, either at once or after some hours, it is potash; otherwise the alkali present is soda.

5. CHALK, WHITING, BURNT BONES, PLASTER OF PARIS, and similar substances are easily detected by calcining a little of the flour or bread in a clean open vessel, when the amount of ash left will indicate the quantity of adulteration. The quantity of the ash left by genuine bread or flour is very trifling indeed, about 2%.

Microscopic Characters of Bread. When bread is placed under the microscope, starch-cells, broken up into angular masses, or greatly enlarged, and stringy masses of gluten are usually visible; besides these, when a microscope of high power is employed, bacteria of the rod-shaped variety may frequently be detected, the source of these being, probably, the yeast. Great caution and diligent observation are necessary to guard against the falling into the serious error of mistaking the many curious forms the broken-up wheat-starch presents for adulterants. By practice and the constant examination of the characters of unadulterated bread, combined with a practical knowledge of the appearance different starch-grains present, after being more or less changed in shape by cooking, the microscopist may identify rice-flour, bean-flour, and Indian millet. Barley-flour and potatoes, however, are very difficult of detection. There is very little difference in the shape of the barley-starch granule and that of the wheat, and in the process of bread-making the potato granules are so changed as to confuse all their distinctive characters. Bone-dust and a few other mineral adulterations may be detected by the microscope.

Concluding Remarks. A number of processes are used by cooks and confectioners to make the different varieties of fancy bread, cakes, puddings, &c., which vary according to the peculiar characteristic it is desired to communicate to them; but none of these articles properly belong to the trade of the common baker. Thus, some kinds of cakes and pastes are made to eat 'short,' as it is called, or are rendered less tenacious, and a species of brittleness imparted to them by the

addition of starch, rice-flour, or sugar. In pastry a similar effect and peculiar lightness is produced by butter or lard, whilst in some articles white of egg, gum water, isinglass, and other adhesive substances are added to produce an exceedingly light and porous mass.

The chief varieties of bread at present in use in this country are known according to their shapes, as—BRICKS, COBURG, COTTAGE, BATCH, FRENCH ROLLS, and RYE BREAD. These vary in their quality, chiefly according to the flour of which they are formed, and their various flavours depend upon the heat of the oven in baking. The best WHITE BREAD is made from the purest wheat-flour; ordinary WHEATEN BREAD, of flour containing a little of the finest bran; SECONDS, from flour containing a still larger proportion of bran; and common HOUSEHOLD BREAD, from flour produced by grinding the whole substance of the grain without any separation from the bran. The last variety is undoubtedly the most wholesome and nutritious, although that least frequently used. SYMNEL-BREAD, MANCHET or ROLL-BREAD, and FRENCH BREAD are varieties made of the purest flour, from the finest wheat, a little milk being usually added for rolls, and butter and eggs for choicer purposes. Several other minor kinds of bread are also made, varied by the addition of sundry trifles, as sugar, currants, and other palatable ingredients. The SCOTCH SHORT-BREAD is made from a very thick dough, to which butter, sugar, orange-peel, and spices are added, according to the taste of the maker.

In the manufacture of white bread from damaged or inferior flour a large quantity of alum is employed by the fraudulent baker, as already noticed; but with the 'best flour' no alum is required. The utmost beauty, sponginess, and sweetness may be given to bread without the addition of one particle of alum, provided the best materials alone enter into its composition. As such materials are seldom employed by the bakers, the usual practice is to introduce 4 or 5 *oz.* of alum to every sack of flour, or about 1 *oz.* to each bushel; and very frequently fully double this quantity of alum is employed. But even this enormous quantity is often not the whole of the alum present in common bread; for the miller, in order to cheat the baker, puts in the 'doctor,' in the shape of 4 to 6 *oz.* of alum to the sack, whilst the baker, unconscious of this victimisation, subsequently uses a double dose of alum in order to cheat his customers. The common excuse of the bakers for using alum is, that without it the bread is not sufficiently white to please their customers, and that the batches are not easily parted into loaves after baking; but Liebig has shown that clear lime-water, which is perfectly harmless, will effect the same object if substituted for the simple water used to make the dough. The method of detecting this pernicious adulteration has been already explained. The proper quantity of salt is 4 *lbs.*, and never more than 5 *lbs.*, to the sack, or 1 *lb.* per bushel. One sack of the best flour, with 4 or 5 *lbs.* of salt, yields about 360 *lbs.* of good bread; and a sack of seconds, 345 to 350 *lbs.* of bread; each being moderately baked. If the loaves are well-baked or over-baked, the product will be from 345 to 350 *lbs.* only; but if they are slack-baked or under-baked, from 370 *lbs.* to 385 *lbs.* of crumbling bread may be obtained from 1 sack of good white flour.

The attention of chemists has, at various times, been directed in search of some method to rectify or lessen the effects of bad harvesting and improper storage on grain, so that a damaged or inferior article might be rendered serviceable, and available for human food. Prof. E. Davy recommends the addition of ¼ *oz.* of carbonate of magnesia to about every 3 *lbs.* of sour, melted, heated, and similarly damaged flour. This substance materially improves the quality of the bread, "even when made from the worst new seconds flour;" whilst it is said to be perfectly harmless; and the bread so prepared, for temporary use, is certainly unobjectionable. What effects would arise from the daily consumption of such bread for several months has not been determined; but it is doubtful whether it would prove salutary. Indeed there are sufficient reasons for condemning the adoption of such bread in the general diet of a people for any very lengthened period. See GOITRE, MAGNESIA, &c. Our own experiments in bread-making, extending over a long period of years, lead us to prefer carbonate or bicarbonate of soda for the purpose. Theoretically, the corresponding salts of potassa would be preferable. A mixture of equal parts of the bicarbonates of potassa and of soda will, perhaps, ultimately be found to be more useful than either substance used separately.

In times of scarcity and famine various substances, besides the flour of the cereals, have been made into bread, or have been mixed with it, in order to lessen the quantity of the former required by the people. For this purpose, almost every amylaceous vegetable at once plentiful and cheap has, in its turn, been eagerly appropriated. Acorns, beech-mast, the leguminous seeds, numerous starchy bulbous roots, and similar substances, have been employed, either in the form of meal, or made into an emulsion or jelly, which has been used instead of water to form the flour of bread-corn into a dough. At such times bran, the most nutritious and valuable portion of the grain, although usually rejected as worthless, has been retained in the flour, and has even been added to it in excess. Birkenmayer, a brewer of Constance, during a period of scarcity, succeeded in manufacturing bread from the farinaceous residue of beer (brewers' grains). 10 *lbs.* of this substance, rubbed to a paste, with ½ *lb.* of yeast, 5 *lbs.* ordinary meal, and a handful of salt, produces 14 *lbs.* of BLACK BREAD, which is said to be "both savoury and nourishing." The nutritious quality of brewers' grains is shown by their extensive employment at the present day as food for pigs and cattle, and particularly for milch cows. In like manner Iceland, Carragheen, and other mosses, have been made into bread, either alone, or mixed with flour or meal. They are used, in the first case, in the state of meal, in the same way as flour; in the second case, 7 *lbs.* of moss are directed to be boiled in 10 or 12 galls. of water, and the resulting glutinous liquid or jelly to be employed to make 70 *lbs.* of flour into dough

which is then fermented and baked in the usual way. It is said that flour thus produces fully double its weight of good household bread. A simpler plan is to mix 1 *lb.* of lichen meal with 3 or 4 *lbs.* of flour; the bitterness of the lichen having been first extracted by soaking it in cold water. Bread so prepared has of late been highly recommended for the delicate and dyspeptic. The modern baker is in the habit of mixing large quantities of potatoes with his bread, whenever he can purchase them at paying prices. Mealy potatoes are selected, and are carefully mashed or pulped, and the dry flour is worked into this pulp or dough, which is then mixed with the sponge in the usual manner. For inferior bread, equal weights of potato pulp and dry flour are often used. Bread so prepared eats 'short,' and is deficient in sponginess, and in that fine yellowish-white tint which forms one of the characteristics of pure wheaten bread. More recently, rice boiled with water to a jelly has got into very extensive use among the bakers. A 'sponge' is made with a portion of the jelly thickened with some flour, and the whole process is conducted in the ordinary manner, except that the fermentation is generally more slowly conducted and allowed to proceed for a longer period. Flour so treated yields fully 50% more bread than when merely mixed up with yeast and water. This constitutes the process of Messrs Morian, Martin, and Journet, of Paris, which was tested a few years since at the Marylebone Workhouse. The experiment succeeded, but the only result to the public has been that the common bakers have adopted the plan, and now very generally surcharge their bread with such an excess of water that, in many cases, it only possesses two thirds the amount of nourishment which it did before the publication of the system just referred to. Unfortunately, the cupidity of dishonest tradesmen appears to be continually impelling them to avail themselves of the exertions of philanthropists and the discoveries of science, in order to increase their profits, regardless alike of the quality of their commodities and the health of their customers. Bread containing an excess of water rapidly becomes sour and mouldy, and is apt to disorder the digestive functions of those who eat it.

From the experiments of Dr Colquhoun, it appears that the starch of flour is partially converted into sugar during the process of fermenting and baking the dough, and thus contributes to the sweetness of the bread. He proposes to add to the flour, arrowroot, the farina of potatoes, and similar amylaceous substances, made into a jelly with hot water, for this purpose. Dr Percival has recommended the addition of salep with the same intention. 1 *oz.* of salep dissolved in 1 quart of water, 2 *lbs.* of flour, 80 *gr.* of salt, and 2 *oz.* of yeast, gave 3 *lbs.* 2 *oz.* of good bread. The same weight of materials, without the salep, gave only $2\frac{3}{4}$ *lbs.* If too much salep is added, it gives its peculiar flavour to the bread.

In reference to the above substitutions, and to the relative quantity of bread produced from any given weight of flour, the reader should remember that the mere increase of the weight or bulk of the product does not carry with it a corresponding increase of the nutritive elements contained in the flour. These remain the same in all cases; and just in proportion as the product, in bread, is greater, will be the decrease in the value of such bread as food. So also with potatoes, rice, and other farinaceous and pulpy substances used as substitutes for wheat-flour. Their poverty in nitrogenous matter, or flesh-formers, is so great, that the greatly increased quantity required as food to support the body, apart from mere inconvenience, more than compensates for their apparent low price. Thus, good wheaten bread, at 2*d.* per *lb.*, is more than twice as cheap as potatoes at 1*d.*; for, assuming 2 *lbs.* of the first as a day's food, 10 *lbs.* of the last will be required for the same purpose; and even this large quantity will scarcely effect the desired object. Liebig has demonstrated that, regard being had to the nutritive power of wheat, it is, under all ordinary circumstances, the cheapest article of food provided by nature for man.

We have not entered into particulars respecting oven management, because, on the large scale, it is thoroughly understood by every practical baker. For the instruction of the busy housewife, however, we may state that the oven should always be sufficiently heated before the bread is put into it, in order that the gas contained in the cells of the 'sponge' may be expanded as rapidly as possible by the heat, and the resulting light mass quickly rendered sufficiently solid to prevent its subsequent collapse. The heat should also be maintained at nearly the same temperature during the whole of the time the bread is submitted to its action. In general, with ordinary kitchen ovens properly heated, 30 minutes' baking is sufficient for 1-*lb.* loaves and cakes; and 15 minutes in addition for every pound after the first for larger ones. Thus, a 1-*lb.* loaf requires $\frac{1}{2}$ hour; a 2-*lb.* loaf, $\frac{3}{4}$ hour; and a 4-*lb.* loaf, $1\frac{1}{4}$ hours.

It is the common ambition of the English baker to give that peculiar tint to the crust of his bread in the process of baking which is so highly esteemed by connoisseurs, and so successfully produced by the Viennese and Parisians. It has been long known at Vienna that if the hearth of an oven be cleaned with a moistened wisp of straw, the crust of bread baked in it immediately afterwards presents a beautiful yellow tint. It was thence inferred that this peculiarity depends on the vapour, which being condensed on the roof of the oven, falls back on the bread. At Paris, in order to secure with certainty so desirable an appearance, the hearth of the oven is generally laid so as to form an inclined plane, with a rise of about 11 inches in 3 feet; and the arched roof is built lower at the end nearest the door, as compared with the further extremity. When the oven is charged the entrance is closed with a wet bundle of straw. By this arrangement the steam is driven down on the bread, and a golden-yellow crust is given to it, as if it had been previously covered with the yelk of an egg.

Pure wheaten bread is one of the most wholesome articles of food, and has been justly termed the 'staff of life,' and a certain proportion of it should be taken at every meal.

New and Stale Bread. As has been just stated, bread which has been kept for 24 hours after baking is more digestible, and therefore prefer-

able to that which has been newly baked. This latter exhibits a well-known elastic appearance, and possesses a certain degree of moisture which renders its taste more agreeable to most persons than bread which has been kept for a day or two, and has become firmer and drier in appearance, and which is commonly termed *stale*. It is very generally supposed that this change in properties in bread which has been kept for a few days is owing to the loss of water.

This, however, is not the case. The crumb of newly baked bread when cold contains about 45% of water, and that of stale bread contains almost exactly the same proportion.

The difference in properties between the two is due simply to difference in molecular arrangement. Boussingault found that a loaf which had been kept for six days, though it had become very stale, had not lost more than 1% of its weight when new. The same loaf was then placed in the oven for an hour, and at the end of that time it had acquired all the properties and appearance of new bread, although during the second baking it lost 3½% of water. In another experiment a portion of bread was allowed to become stale when enclosed in a tight case, to prevent loss of water by evaporation; it was then heated, and was thus restored to the condition of new bread; these effects were produced alternately, many times in succession, upon the same piece of bread; a heat of about 131° F. was found sufficient to convert stale bread into new bread. Every person who has seen a thick slice of stale bread toasted may have satisfied himself that the crumb has during this operation been converted into the same condition as that of new bread.

Fungi. When bread has been kept a few days and has become stale, certain species of fungi show themselves in it: these are the *Penicillium glaucum*, which is the green mould of cheese; the *Fermentum cerivisiæ*, or yeast fungus; the *Oidium aurantiacum*, or orange-red mould; the *Puccinia graminis*, and others. Excess of salt added to the bread prevent the development of these fungi.

Diseases arising from the Employment of Unsound Flour and Bread. The flour may be ergotised or grown, and fermenting from the presence of fungi. All the poisonous symptoms of ergot are induced from continuously partaking of bread made with ergotised flour. Dry gangrene is one of the most virulent forms of poisoning caused by partaking of ergotised bread. Severe intestinal derangement is an accompaniment of the milder forms of poisoning. Ergot is more frequently present in rye-flour than in wheat. Fermenting bread is a fertile source of dyspepsia, whilst acid bread causes diarrhœa. This latter malady is also caused by the presence in bread of the *Oidium aurantiacum.* Professors Varnell and Tuson state that mouldy oats, the mould being caused by a fungus (*aspergillus*), have given rise to paralytic symptoms in horses, so that the presence of these fungi in oats used for making bread should always be regarded with considerable caution.

It has not been demonstrated that the *acarus* so common in flour has had any injurious effect when eaten. When well fermented and baked, bread is very easy of digestion. It should never be eaten until it has stood at least 24 hours after being taken out of the oven. When newer, bread is apt to disagree with the stomach, frequently producing indigestion, biliousness, diarrhœa, dyspepsia, and other like ailments. Young infants should never be fed upon bread. See ALEUROMETER, ALUM, FLOUR, WHEAT, &c.

Bread, Aërated. The best description of unfermented bread is that manufactured by the process of Dr DAUGLISH. The method of manufacture has this advantage: During the whole of the operation neither the flour nor the dough comes into contact with the flesh of the workman. For a full description of the method of preparing this article, *see* Watts' 'Dict. of Chemistry.' See BREAD, UNFERMENTED.

Bread, American. From American barreled flour. "14 *lbs.* of American flour will make 21½ *lbs.* of bread; whereas the best sort of English flour produces only 18½ *lbs.* of bread" (*Mrs Rundell*). This arises from the superior quality of the wheat used in its production; and also from its being kiln-dried before grinding, by which much water is driven off.

Bread, Bee. The matter collected by bees to form the bottom of the hive. It resembles a mixture of resin and wax. Its fumes were formerly thought to be anti-asthmatic.

Bread, Bran. 1. From the whole meal, without sifting out any of the bran.

2. By adding about 3 *oz.* of bran to every 1 *lb.* of ordinary flour.

Bread, Cassava, is made from the root of the *manihot*, by first expressing the juice, then grinding the residue into a coarse meal, and baking it in the form of cakes upon thin iron plates. When steeped in oil and flavoured with cayenne, and slightly broiled upon a gridiron, it is not unpalatable.

Bread, Extemporaneous. See BREAD, UNFERMENTED.

Bread, French. *Prep.* 1. From fine flour, as the best white bread. For the better kinds, and for those intended for rolls and small fancy bread, the sponge and dough is commonly wetted with milk and water, and occasionally a very little butter is added. "When the rolls or small fancy loaves have lain in a quick oven about a quarter of an hour, turn them on the other side for about a quarter of an hour longer. Then take them out and chip them with a knife, which will make them look spongy, and of a fine yellow; whereas rasping takes off this fine colour, and renders their look less inviting."

2. FRENCH SOUP-BREAD. From fine flour, but employing fully double the usual quantity of salt. It is baked in thin loaves, so as to be nearly all crust, by which means it becomes more soluble in hot soup.

Bread, Hicks's Patent. This is ordinary bread baked in an oven so arranged that the vapours arising during the process are condensed in a suitable receiver. The condensed liquor is a crude, weak spirit, produced during the fermentation of the dough, and possesses little commercial value; indeed, insufficient to pay for the expenses attending its collection. Besides which, the bread prepared under this patent was rejected by the vulgar, who flocked to the shops of the

neighbouring bakers, who professed to sell their bread with "the gin in it."

Bread, Household. This name is commonly given to bread made with flour from which only the coarser portion of the bran has been removed; and to bread prepared from a mixture of flour and potatoes. The following are examples:

1. (*Rev. Mr Haggett.*) Remove the flake-bran from flour, 14 *lbs.;* boil the bran in 1 gall. of water until reduced to 7 pints; strain, cool, and knead in the flour, adding salt and yeast as for other bread. Very wholesome.

2. Flour, 7 *lbs.;* mealy potatoes (well mashed), 3 *lbs.;* as before. Objectionable for the reasons already given.

Bread, Leav'ened (lĕv'-). Using leaven instead of yeast, and in the same way. About 1 *lb.* to each bushel of flour is usually sufficient. The more leaven used, the lighter the bread made with it will be; and the fresher and sweeter the leaven, the less sour will it taste. Leaven, except among the Jews and sailors, is now superseded by yeast.

Bread, London White. The common proportions of the London bakers are—Flour, 1 sack; common salt, 4½ *lbs.*; alum, 5 *oz.*; yeast, 4 pints; warm water for the sponge (about), 3 galls. The process has been already noticed.

Bread, Paris White. The following has been handed to us as the plan commonly adopted by the Paris bakers for their best white bread: On 80 *lbs.* of the dough (before the yeast was added) from yesterday's baking, as much luke-warm water is poured as will be required to make 320 *lbs.* of flour into a rather thin dough; as soon as this has risen, 80 *lbs.* are taken out and reserved in a warm place as leaven for the next day's baking; 1 *lb.* of dry yeast, dissolved in warm water, is then added to the remaining portion, and the whole lightly kneaded; as soon as it has sufficiently risen, it is made into loaves, and shortly afterwards baked; the loaves being placed in the oven without touching each other, so that they may become crusty all round.

Bread, Unfermented. *Syn.* Extemporaneous Bread. *Prep.* 1. From Jones's patent flour. Very wholesome and excellent; indeed, when skilfully made and baked, almost equal to French bread.

2. From Sewell's patent flour. Slightly inferior to the last.

3. To each *lb.* of flour add, separately, 1¼ *dr.* of bicarbonate of soda, and 1 *dr.* of tartaric acid (both perfectly dry, and in very fine powder); rub them well together with the hands until thoroughly incorporated; then form the whole into a dough with water as quickly as possible, and at once bake in a quick oven. About 8 or 9 *oz.* of water are required for every *lb.* of flour. Answers well when expertly managed.

4. Flour, 1 *lb.;* bicarbonate of soda, 1 *dr.;* mix; make a dough with water, q. s., to which 1 *dr.* of hydrochloric acid (commercial) has been added, and further proceed as before.

5. Whiting's Patent Bread. This closely resembles the last. The proportions are: Flour, 7 *lbs.;* carbonate of soda and hydrochloric acid, of each, 1 *oz.;* water, 2¾ pints. This method was suggested by Dr Henry in 1797, and was patented by Dr Whiting in 1836. If the proportions be not observed or the mixture be not perfect, the quality of the bread suffers. The action of the acid on the soda forms common soda in the loaf.

6. Ammoni'acal Bread. Carbonate of ammonia, ¾ to 1 *oz.;* cold water, q. s.; dissolve, add of flour, 7 *lbs.;* and make a dough, which must be formed into loaves and baked immediately, as before.—*Obs.* To ensure success the carbonate should be recent and free from bicarbonate, the presence of which is known by its being white and powdery, and of inferior pungency. If any of the last salt be present, the bread will have a yellowish colour and a slightly alkaline or urinous flavour. The process answers best for small loaves, cakes, and fancy bread. By employing pure carbonate of ammonia instead of the commercial sesquicarbonate, the process succeeds admirably, and the resulting bread is most wholesome. A late writer recommends the use of bicarbonate of ammonia, but evidently does so in ignorance, as in practice it is inapplicable, as the author verified by numerous carefully-conducted experiments.

7. It has been at various times proposed to knead the dough with water highly charged with carbonic acid, on which Dr Ure observes that "the resulting bread will be somewhat spongy." He states that he endeavoured to make bread in this way, but never could succeed in producing a light spongy loaf. The quantity of gas in the water is much too trifling for the purpose, and the greater part of it escapes in the process of making the dough, even though all the materials be well cooled, and the operation conducted in a cold place. The only way of obviating the difficulty is to conduct the kneading in a trough under considerable atmospheric pressure, and at a very low temperature by means of machinery, as is done by Dr Dauglish, whose method is now protected by letters patent. This method is not, however, adapted either to domestic use or the small scale. For a full description of Dauglish's process, see Watts's 'Dict. of Chemistry.'

Obs. Unfermented bread has been strongly recommended as being more wholesome and generally better adapted to bilious and dyspeptic patients than fermented bread. It must, however, be confessed that the unfermented bread commonly met with has a slight 'raw-grain' taste, which is very disagreeable to some persons. But this taste is not necessarily present, being chiefly dependent on bad manipulation, the use of inferior flour, and insufficient baking. The process of fermentation doubtless modifies the condition of the starch and gluten of the dough, and renders them easier of digestion. This species of bread is sadly adulterated with a variety of indescribable messes. See Biscuits, Bread (*antè*), Flour, Gingerbread, &c.

BREAD-FRUIT (*Artocarpus incisa,* Nat. Ord. Graminaceæ). The tree yielding the bread-fruit is a native of Central America, the South Sea Islands, and the Islands of the Indian Archipelago. It is principally composed of starch, sugar, and water, every 100 parts containing 80 of water. The fruit is gathered when the starch is in a mealy condition; it is then peeled, wrapped in leaves,

and baked by placing it between hot stones. It then has the taste of sweetbread.

The natives of the countries where this fruit is found practise a method for preserving it, which consists in allowing the nitrogenous parts of the fruit to putrefy in water-tight pits. They thus obtain a mass resembling soft cheese in consistence; and this, when required to be eaten, is baked in the same manner as the fresh fruit.

Bread-fruit, Okwa or African (*Treculia africana*, Dec.). The nuts are ground into meal and eaten by the natives of west tropical Africa.

BREAK'FAST (brĕk'-). *Syn.* Jentaculum, L.; Déjeûner, Déjeûné, Fr.; Frühstück, Ger. The first meal of the day; or the food served at it.

The morning meal—the 'early bit' of the Germans—is perhaps the most important one of the day. According to Erasmus Wilson, it is usually "taken at eight or nine." The proper time for the purpose must, however, depend upon that at which the individual rises. About an hour to an hour and a half after leaving the bed will generally be found the most appropriate time for breakfast, and appears to be the one pointed out by nature, and the most conducive to health. By that time the powers of the system have fully recovered from the inactivity of sleep, and the functions of the stomach and other viscera have again come into play. If abstinence is now prolonged, the physical and mental energies, unsupported by the supply of food which indirectly gives them birth, gradually lessen, and incipient exhaustion ensues. An unpleasant feeling of hunger or a loss of appetite comes on, with all its depressing consequences. When breakfast cannot be taken within a reasonable period after rising, the gap should be filled up by chewing a crust, a biscuit, or the like. A raw egg or two, sucked from the shell, or broken into a teacup and drunk, will be found most valuable for this purpose. Raw milk, cheese, salted food, and other indigestible matter should be particularly avoided at this early period of the day.

The articles of food to be chosen for the breakfast-table must depend entirely on the state of the health, the occupations, &c., of those assembled round it. Coffee appears to be, by common consent, the favourite beverage. For the delicate, the bilious, and the young, it should neither be taken too strong, nor very weak, and should be softened down with milk or cream, and well sweetened with sugar. Tea is more apt to affect the nerves and stomach than pure unchicoried coffee. Green tea, taken thus early in the day, often acts as an absolute poison, though a slow one. We have seen severe fits of vomiting and exhaustion follow its use.

The solid food for breakfast should be easy of digestion, and nutritious. Females, children, and persons leading a sedentary life, should confine themselves to a sufficient quantity of good meal-bread with only a moderate quantity of butter, to which an egg, or a small rasher of mild bacon, may be advantageously added. For very young children there is no better breakfast, where it agrees with them, than scalding-hot new milk poured on sliced bread, with a slice or two of bread and butter to eat with it. Persons engaged in active occupations may add to this bill of fare a little ham or cold meat. When an undue time will elapse before the luncheon or dinner, and particularly during the colder season of the year, the broiled leg of a fowl, an under-dressed mutton-chop, or a little tender beef-steak, will be found, by the persons last referred to, most useful—nay, in many cases invaluable. But excess must be particularly avoided. The object is to take enough food to maintain the system in full energy and vigour, and particularly to avoid offending the stomach by overloading it—a misfortune easily effected at the breakfast-table. Old commercial travellers—men wise in the mysteries of life and its enjoyments—are scrupulously careful to make a good, but not a heavy breakfast, before commencing the arduous duties of the day. See Déjeûner, Meals, &c.

The Continental custom of taking a small cup of coffee with a biscuit soon after rising, and two or three hours afterwards eating a good meal, is one which has much to recommend it. Despite much that may be said to the contrary, a good substantial breakfast is an excellent foundation for a hard day's work. Those who cannot eat well in the morning are unfitted for either severe bodily or mental labour during the day; and though they may endeavour to make up for it by a heavy dinner in the evening, the maxim "prevention is better than cure" is the best to act upon.

Breakfast Powder. *Syn.* Rye'-coffee, Dillen'ius's c., Hunt's Econom'ical Breakfast Powder, &c. Rye, roasted along with a little fat, after the manner of coffee. It was once sold at 2*s.* 6*d.* the *lb.*, and was formerly extensively used as a substitute for foreign coffee, of which it is one of the cheapest and best. Since the reduction of duty on coffee it has nearly fallen into disuse, unless it be by the grocers to adulterate that article.

BREAST (Sore). See Nipples.

Breast Pang. *Syn.* Angina pectoris. *Symptoms.* A sudden pain occurring in the parts covered by the breast-bone and the throat, accompanied with a feeling of suffocation, and the apprehension of immediate death. The pain sometimes extends down the arms and through the back. Summon a medical man without a moment's loss of time. Pending his speedy arrival give a drachm of ether with one third of a grain of acetate of morphia. Apply hot applications to the chest and stomach; likewise friction to the chest, back, and sides with spirits. If the relief be only partial, the dose of ether may be repeated after 20 minutes.

True angina is a very terrible accompaniment of certain forms of heart-disease. A drop or two of amyl nitrate on a handkerchief applied to the patient's nostrils will often afford almost sudden and complete relief; persons liable to it should seek medical advice as to their mode of life, so that they may as far as possible avoid provoking an attack.

BREATH (Fetid). Scarcely anything is more disagreeable or disgusting than a stinking breath. Various means have been proposed to remove this annoyance, depending principally on the administration of aromatics, which by their odour smother it for a time; but these require continual repe-

tition, and are liable to interfere with the functions of digestion. The real cause of stinking breath may generally be traced to a diseased stomach, or to decayed teeth. When the former is the case, mild aperients should be administered, and every possible means taken to restore the digestive functions to a healthy state. When rotten teeth are the cause, they should be thoroughly cleansed, and then 'stopped;' or, if this is impracticable, they should be removed. When this is impossible or inconvenient, the evil may usually be lessened by keeping them scrupulously clean. Dirty teeth also often cause the breath to smell; and hence the use of the tooth-brush should be a daily habit. Occasionally rinsing out the mouth with a little clean water to which a few drops of solution of chloride of lime or of chloride of soda has been added, is often an effective method. Mouth-washes of Condy's fluid, and also of carbolic acid, both very greatly diluted, form useful remedies; as do also chlorate of potash and tannic acid in the form of mouth-washes. As a tooth-powder, fresh-burnt charcoal, and particularly areca-nut charcoal, is without comparison the best. Lozenges, such as the following, have been strongly recommended to sweeten and purify the breath: Gum-catechu, 2 oz.; white sugar, 5 oz.; orris powder, 1 oz.; neroli, 5 or 6 drops; make them into a paste with mucilage, and divide the mass into very small lozenges. 20 or 30 drops of oil of cloves may be substituted for the orris and neroli at will. One or two may be sucked at pleasure. When the breath of a child or infant, usually so sweet and fresh, smells unpleasantly, it indicates stomach derangement of some sort. Very frequently it is indicative of worms. See CACHOU AROMATISÉ, PASTILS, &c.

BREWING. The art of making beer. As before stated (see BEER), the brewer has almost entire freedom in the choice of brewing materials.

The following appliances constitute the 'plant' required in brewing beer under the ordinary system:

1. A mash-tun, varying in size according to the proposed scale of brewing.

2. A copper capable of holding at least 3 barrels per quarter of malt used; with a gauge-stick to determine the number of gallons of liquid at any given depth therein.

3. A vessel with a perforated bottom for the retention of the hops and precipitated albuminous matter after the wort has left the copper. This vessel is known as a hop-back.

4. A shallow wooden cooler.

5. A copper refrigerator for the rapid cooling of the wort.

6. One or more fermenting tuns. These may be of wood, and should be preferably of a round shape, since corners, in which accumulations of dirt might occur, will be thus avoided. Their size will, of course, depend upon the amount of beer to be brewed, but in all cases plenty of space must be allowed for the rising of the yeast. They should be provided with either a sluice or a parachute arrangement for the removal of the yeast.

7. A wooden vessel for the reception of the beer after leaving the fermenting tun, and known as a 'settling-back,' is also extremely useful and desirable.

8. A pump worked either by steam-power or by hand will, in most cases, be necessary.

In addition to these articles many smaller pieces of apparatus, such as thermometers, saccharometers, pails, &c., will be required. A malt-mill may be dispensed with in private brewing, as the malt may be procured already crushed.

Brewing Water. Of late years the necessity of using, for the production of beer, water which is both organically pure, and, from the nature of its mineral constituents, suited to the purpose, has been recognised by brewers. Rain-water falling upon the earth and percolating through the various geological strata, owing to its great solvent powers, dissolves out larger or smaller quantities of the various mineral substances with which it comes into contact. Hence on evaporating to dryness a quantity of any spring or well-water, we shall always obtain more or less mineral residue, which may vary from 1 or 2 gr. per gall. to 100 gr. per gall. or more. Natural waters may be divided into two large classes: 1, soft water; and 2, hard water. It is a matter of common observation that some waters require more soap to form a lather than others. This difference is due to the presence in the one of salts of lime and magnesia which, forming insoluble oleates, palmitates, and stearates, prevent the soap from producing a lather. Waters containing much lime and magnesia salts are termed 'hard,' those containing little of these substances are termed 'soft.' Hardness again is of two kinds—'temporary' and 'permanent.' Carbonates of lime and magnesia are not sensibly soluble in water unless carbonic acid be present. In this case soluble acid-carbonates are formed, and thus it is that these salts are found in well-waters. The acid-carbonates are, however, very easily decomposed on boiling the water, carbonic acid being expelled and the insoluble carbonates formed. Thus:

$$CaH_2(CO_3)_2 = CaCO_3 + H_2O + CO_2$$
$$MgH_2(CO_3)_2 = MgCO_3 + H_2O + CO_2.$$

Waters containing these soluble acid-carbonates in solution are said to possess 'temporary hardness,' because on boiling the carbonates are precipitated and the water becomes 'soft.' Such is not the case, however, with the sulphates of lime and magnesia. These salts are not thrown out of solution on boiling, and hence they confer the property of permanent hardness on the water. The sum of the temporary and permanent hardness is known as the 'total hardness.' Hard water is to be preferred in the brewing of pale and bitter ales, since it extracts less colouring matter, and, what is more important, less albuminous matter from the malt. This albuminous matter when present in excess, remains in the finished beer, where, from its changeable nature under the influence of bacteria, and its unpleasant consequences, it becomes a source of constant anxiety and trouble to the brewer. The Burton brewing waters contain large quantities of sulphates of lime and magnesia.

Analysis of the Water used in Messrs Allsopp's Brewery (Dr Böttinger).

	Grains per Gallon.
Carbonate of lime	15·51
Carbonate of magnesia	1·70
Sulphate of lime	18·96
Sulphate of magnesia	9·95
Chloride of sodium	10·12
Sulphate of potash	7·65
Carbonate of iron	0·60
Silica	0·79
Total solid matter	65·28

In the brewing of porter and stout, where a full-flavoured article is required and where the colour hides any cloudiness that may be produced by separated albuminous matter, a 'softer' water is to be preferred. The German brewer likewise uses a soft water, whereby he extracts the amount of albuminous matter that he requires. Since we find that a hard water is necessary for the successful production of pale ales, it becomes a matter of interest to see whether a naturally soft water cannot be artificially hardened. This may be done satisfactorily by adding 2 oz. of powdered gypsum and ½ oz. Epsom salts (sulphate of magnesia) per barrel of water used in mashing and sparging in the hot liquor tank. It must be remembered that only after having made a full analysis of the water is it possible to tell in what constituents it is defective and what amounts of these salts are to be added to render it suitable for brewing. The alkaline chlorides also decrease the amount of albuminous matter extracted, and at the same time increase the keeping properties of the beer. Since nitric acid results from the oxidation of organic matter, the presence of that body in any quantity in a water, unless satisfactorily accounted for, is to be looked upon with suspicion. Large quantities of 'free' and 'albuminoid' ammonia are indicative of sewage or vegetable contamination.

Malt. *Syn.* Bina, Byne, Brasium, Maltum, L. The name given to different kinds of grain, such as barley, oats, rye, &c., which, after having been allowed to germinate to a certain extent, have been dried on a kiln. Barley is the grain usually employed for this purpose. Independently of varieties of quality or of the grain from which it is prepared, malt is distinguished into varieties, depending on the heat of the kiln employed in drying. 'Pale malt' is dried at a final temperature of 170°—180° F. In preparing 'amber malt' the final temperature is raised to 200°—220° F. Roasted, patent, or black malt and crystallised malt are prepared by a process similar to that of roasting coffee. The malt is placed in sheet-iron cylinders over a strong fire, and the cylinders made to revolve at the rate of about 20 revolutions per minute if roasted malt is required, or 120 for crystallised malt. The temperature must never exceed 420° F., or the malt will be completely carbonised.

Qual. Good malt has an agreeable smell and sweet characteristic taste. It is crisp and friable, and a grain should be easily broken with the thumb-nail. When broken between the teeth it should not exhibit any 'steeliness,' which is indicative of incomplete growth. The husk should be thin and unshrivelled in appearance, and the acrospire should be seen extending through three fourths of the length of the grain beneath the skin. Admixture of unmalted grain may be detected by the absence of the acrospire and by the sinking of the unmalted grain when some of the sample is thrown into water. A bushel of pale malt will weigh from 39 to 44 lbs. The moisture in a sample of malt may be determined by grinding some of the sample in a coffee-mill and weighing out quickly 5 grms. This is then dried in an air-bath at 100° C. until the weight remains constant, which will usually be in about 8 or 9 hours. The amount should not exceed 5%. The 'extract per quarter' and the total soluble matter may be obtained in the following manner: Weigh out 10 grms. of the ground malt into a small beaker, and add 100 c.c. of cold water. Place the beaker and its contents in a water-bath, and heat to 60° C. for 1½ hours. Filter off, wash with boiling water, and make the filtrate up to 1000 c.c.; weigh very carefully two glass dishes, and place in each 100 c.c. of the wort. Evaporate to dryness and dry to a constant weight in an air-bath at 100° C. This will give the total soluble matter from 1 grm. of malt, which multiplied by 100 gives the percentage. The extract per quarter is obtained by multiplying this percentage by the factor 1·26.

Thus: a malt having 70% of soluble solids will give an extract of $70 \times 1{\cdot}26 = 88{\cdot}2$ lbs. per qr.

Prep. The process by which malt is prepared is known as 'malting.' It was formerly believed and stated that the object of malting was to convert the starch of the grain into sugar, a statement which is entirely erroneous. The true object of malting is to develop the active albuminous bodies, known as 'diastase,' by means of which, in the mashing process, the starch is converted into dextrin and maltose. There are four successive stages in the process of malting: viz. steeping, couching, flooring, and kiln-drying.

1. *Steeping.* In this part of the process the grain is allowed to absorb sufficient water to soften it and to start germination. The grain is usually allowed to remain in the steep from 40 to 70 hours, and it is advisable to drain off the water two or three times during the operation. Hard water should be used, the temperature of which should be from 50°—55° F., a higher temperature than the latter favouring the formation of lactic acid.

2. *Couching.* This operation consists in throwing the swollen barley from the steep into the couch frame to a depth of about 20 to 25 inches, where heat is generated and germination induced. It was here that, under the malt tax, the Revenue guage was taken; but, now that the maltster is free in this respect, it is sufficient if the grain be left in the steeping cistern to drain for 20 to 30 hours, according to the nature of the barley and the temperature of the atmosphere. The heat of the couch should not exceed 65° F., a safe temperature being from 58°—60° F. As soon as germination has fairly commenced and the rootlets appear, the couch must be broken down and the grain spread at a less depth.

3. *Flooring.* This consists in spreading the

germinating barley on the floor at different depths, according to the time of the year and the rapidity of germination. The grain must be turned three or four times a day, and at each turning spread out more and more, thereby ensuring uniformity of growth. It should, after about the fifth day, be sprinkled with water at intervals as required. The temperature of the house should not exceed 60° F., and should not vary. Since the diastasic power of a malt increases with the amount of growth, it follows that, if raw grain is to be used in brewing, the acrospire should be pushed further than if such is not the case. As a general rule the acrospire should extend three fourths of the length of the grain. In England the grain is usually on the floor from 8 to 12 or 13 days.

4. *Kiln-drying.* The withered grain is next spread on the floor of the malt-kiln at a depth not exceeding 6 or 7 inches, since in greater thickness it is impossible to effect a thorough drying, for the moisture escaping from the bottom layers merely saturates the upper parts. The majority of the moisture is expelled at a low temperature, which is then gradually increased to 120° F., the malt being frequently turned. The final temperature, as before stated, will depend on the purpose for which the malt is required, The kiln-drying requires usually from 3 to 4 days.

Product. Good barley yields about 80% by weight and 110% by measure of dried and sifted malt. Of the loss by weight 10% or 12% must be referred to water existing in the raw grain.

Preliminary Proceedings. The malt is chosen according to the intended character of the brewing—pale, amber, roasted, or any mixture of these as the occasion may require. It is crushed before being used in brewing, in order that it may be more readily acted on by the water. It should not be ground too fine, otherwise great difficulty will be experienced in extracting the soluble matter from the pasty mixture by means of the sparge.

The quantity and nature of the hops used will depend, of course, on the kind of beer to be brewed. For general purposes those grown in Kent and of the present season are preferred. For the finer sorts of ale, East Kent hops, Farnhams, and the Worcester hops grown in the valley of the Severn are commonly used. These hops are rich both in essential oil and tannin, and are the most highly prized. Sussex hops are often used, but have an inferior colour and flavour. With regard to foreign hops Dr Graham says: "Among French hops, those grown in Alsace are, perhaps, some of the best. The Belgians are much inferior, especially those grown near Alost, which are rather coarse. The finest hops perhaps in the world are those grown in Bohemia. . . . . As regards Bohemian hops, the well-known hops grown near Spalt stand in the first order for their value in cleansing and beer-keeping qualities. Next to them come those grown near Kinding, Wolznach; then those of Weingarten, Stirn, and Hersbruck. The Wurtemberg hops are rather fine. The Baden-Baden hops rank next to those I have mentioned."

English hops are packed in sacks of canvas termed 'pockets,' weighing from 1¼ to 1¾ cwt. each. Hops twelve months old are known as 'yearlings,' when of the second season's growth, 'old,' and when three years or older, 'old olds.' The quantity of hops employed per quarter of malt varies from about 2 lbs. to 20 lbs. The following are the usual proportions:

Table beer . . .	About 2 lbs.	per 1 qr. malt.
Porter and stout .	„ 6 lbs.	„ „
Bitter beer . . .	„ 10 lbs. to 14 lbs.	„ „
East Indian pale ale (export) . . .	„ 12 lbs. „ 20 lbs.	„ „

Process of Brewing. 1. *Mashing.* The object of the brewer in this part of the process is to convert the insoluble starch of the malted grain into soluble saccharine substances which shall be capable, subsequently, of being converted, under the influence of the yeast organism, into alcohol and carbonic acid gas. It is obvious that he desires this conversion to be complete, or, in other words, that he wishes to obtain as great an amount of extract as possible. This conversion is effected by means of the active soluble albuminoid bodies (known as diastase) which it has been the principal object of the malting process to develope. Diastase acting on starch-paste at a suitable temperature converts it into a mixture of maltose and dextrin, the proportion of these bodies varying with the temperature, the consistency of the mixture, &c. The dextrin, however, is converted in turn into maltose, so that after a sufficiently prolonged action, this body would remain the sole product. The conversion of the dextrin into maltose may be represented thus:

$$\underset{\text{Dextrin.}}{C_{12}H_{20}O_{10}} + H_2O = \underset{\text{Maltose.}}{C_{12}H_{22}O_{11}}$$

A series of valuable experiments made by Dr Graham show that the ratio of the maltose to the dextrin produced in this reaction depends principally on three factors, viz. temperature, time, and quantity of water. These he terms the factors of hydration. From his experiments we learn in the first place that *the higher the temperature at which the mashing operation is conducted the greater is the ratio of dextrin to maltose.* At the same time the amount of total sugars formed diminishes. With regard to the influence of time, we find that *as the duration of the mash is increased, the ratio of maltose to dextrin becomes greater,* and at the same time there is a small continuous increase in the amount of total sugars formed. The proportion of water to malt is the third of these hydration factors. We find that *as this proportion becomes greater the ratio of maltose to dextrin increases.*

The growth of the acrospire and the final heat on the kiln-floor are two other factors affecting the ratio of maltose to dextrin, but in a lesser degree. A wort containing a large proportion of dextrin to maltose will produce a beer of considerable palate fulness, whilst a wort in which the amounts of these bodies are reversed will give rise to an alcoholic beverage possessing but little body. Seeing, then, that the final character of a beer can be governed to a very great extent in the mash-tun, the immense importance of these results will be apparent. In addition to effecting the conversion of the starch into maltose and dextrin, the brewer desires to extract from the malt suffi-

cient albuminous bodies for the healthy development of the yeast during the fermentation process. Owing to the changeable nature of these bodies, a larger quantity than will suffice for this purpose must be avoided as far as possible.

In the English infusion process two methods of making the mixture of water and malt may be employed. These may be roughly described as—

(1) Running the grist into the requisite amount of water.

(2) Running, by means of an external machine, the mixture of grist and water at the proper temperature together into the mash-tun.

In the first method an amount of water corresponding to about 2 barrels per quarter of malt, at a temperature of 160°—163° F., is first run into the tun. The grist is then allowed to fall from a hopper, and the mashing machinery (rakes or oars) kept in motion during the time of falling.

In the second method external mashing machines, such as those of Steele and Maitland, are made use of. In those machines an intimate admixture of the water and grist is made before they reach the tun. The temperature of the mashing liquor should be about 166° F., and a sufficient quantity of water to prevent the falling mash from blocking up the false bottom should be first run into the tun. It is advisable that rakes should be fitted to the mash-tun, even when outside mashing machines are used, as a perfect control over the mash is then ensured. Of these two methods the latter is by far the best, as 'balling' is prevented and a more thorough mixture obtained. The first method is not so good, but should it be impossible to make use of a tun fitted with outside masher and rakes, the first method must be adopted. The quantity of water employed is usually from 1½ to 2 barrels per quarter of malt. The following method of mashing gives good results :—The requisite quantity of water at a temperature of 160° F. being in the mash-tun, the grist is run in, during the whole of which time the rakes or oars are kept in motion; 2 or 3 barrels of 'liquor,' at a temperature of about 185° F., may then be run in under the plates, giving an initial heat of about 151° F. The tun is then covered and the mash allowed to stand for 1¾ hours. Remembering the influence of the duration of the mash on the maltose and dextrin ratio, it will be seen that the time of standing-on the goods will depend upon the nature of the beer to be brewed—whether full-flavoured or alcoholic. In the case of stout the time may be reduced to 1¼ hours, and for an alcoholic beer it may be as much as 2 hours. At the expiration of this time 'tap is set' and the wort is run into the copper. The tap-heat will be about 148° F. Another mash may now be made with liquor at a temperature of about 170° F., giving a tap-heat of about 158° F. Instead of this second mash the 'goods' may be simply 'sparged' with water at a temperature of 170° F. A solution of iodine is a useful test for the presence of starch in a wort, but it must be remembered that the blue colour is also produced by finely disintegrated cellulose, and consequently that the last runnings will usually give a slight colour with this reagent. The wort is usually run from the mash-tun into a vessel termed an 'underback' from which it is pumped into the copper, but it may also be run direct into the copper through a small vessel known as a 'receiver.' When sugar is used, it may either be added in the underback or in the copper.

2. *Boiling.* The wort, having been transferred to the copper, is heated to the boiling-point as quickly as possible, to prevent the formation of acidity. In the copper there is a continuation of the action of rendering insoluble the albuminoids, which was commenced on the kiln. Three objects mainly are effected by the boiling of the wort. In the first place there is the coagulation of some of the albuminous matter, due partly to the high temperature and partly to the tannin extracted from the hops (insoluble tannate of albumen being formed). The second object is to render inactive the diastase, and thus to prevent further conversion of dextrine into maltose; and the third object is to extract from the hops their bitter and preservative principles. As soon as the boiling of the wort commences the hops are added, and the boiling is continued. If the whole of the wort is to be boiled at once, the boiling should be continued for at least 2 hours—if in two coppers, then the first should be boiled 1½ hours, and the second 2 hours. A somewhat shorter period of boiling is necessary for running ales than for store ales, which have to be kept for some time. When the wort is boiled in two lengths, the hops from the first copper may be added, together with some fresh hops, to the wort in the second copper. The average loss by evaporation in the process of boiling varies from one sixth to one seventh of the original bulk of the wort.

3. *Cooling.* The wort, after leaving the copper, is run into a vessel known as a 'hop-back,' where it is filtered through a perforated plate, and is by this means separated from the hops. It is usual when the wort is boiled in two lengths to return these hops to the second copper. The wort must now be rapidly cooled to a temperature of about 60° F., the temperature at which the yeast is to be added. The necessity for rapid cooling will be apparent if it be remembered that disease organisms (lactic, butyric, &c.), which are always present in the atmosphere of a brewery, and which must consequently fall into the cooling wort, are most active at temperatures lying between 70° F. and 90° F. The wort is pumped from the hop-back on to a large, square, shallow vessel known as a 'cooler.' Here the wort deposits more albuminous matter and sediment, partly owing to the reduction of temperature and partly to oxidation. After standing on the cooler for about 20 minutes or half an hour it is run over a refrigerator into the fermenting tun. The refrigerator is a vessel usually constructed of copper, and so arranged that the wort passes over a series of pipes through which cold water is passing. By this device the wort can be cooled down to the pitching temperature in the course of a few seconds. Since the complete cooling of the wort on the cooler would expose it too long to the action of the atmosphere, and consequently to chance of contamination by disease ferments, the value of this instrument

will be obvious. The temperature to which the wort is cooled will depend on the class of beer to be brewed, the time of the year, &c. A temperature of 58° F. is usual for pale ales and 62° F. for stout and porter. 60° F. may be taken as a safe average temperature. In the German system the wort is pitched at a temperature of from 39°—42° F. When the wort is cooled down to the required temperature the necessary amount of yeast is added and fermentation started.

4. *Fermentation.* The cooled wort is next run into the fermenting tuns and the yeast required for its fermentation added. In this, perhaps the most important part of the brewing process, the maltose formed in the mash-tun is converted by means of the yeast-organism into alcohol and carbonic acid gas. The older theory of fermentation was that of Liebig and his school. He held that nitrogenous matter undergoing decomposition acts as a ferment, and by contact action, induces the decomposition of the sugar molecules with which it is in contact. This theory has now entirely given way to the physiological theory of Pasteur, which asserts that fermentation is a consequence of the life of the yeast-cells, and is not due to decomposing albuminous matter. Although alcohol and carbonic acid gas are the chief products of the fermentation of sugar, they are not the only ones. Out of 100 parts of cane-sugar 95 parts only are decomposed into alcohol and carbonic acid gas, 4 parts disappear and form succinic acid and glycerin, and 1 part is added to the newly formed ferment.

Yeast (*Saccharomyces cerevisiæ*), as seen under the microscope, consists of small round or oval cells, having an average diameter of $\frac{1}{3000}$ inch. The cells consist of a cell-wall of cellulose, containing a colourless nitrogenous liquid known as protoplasm. If a cell be carefully examined, one or more small circular spaces will be noticed, —spaces filled with a liquid of less density than the protoplasm. These are known as 'vacuoles.' In addition to these vacuoles, a number of small dark spots ('granulations') may be seen. A good sample of yeast is recognised by well-developed cells, having well-marked vacuoles and few or no granulations. The yeast-organism reproduces by a process known as 'budding.' A slight prominence arises from the surface of the cell, which enlarges, whilst at the same time the bond of union becomes smaller in diameter. When it has attained the size of the parent cell, it separates from it, and in its turn produces others in the same manner. The yeast-organism is most active at temperatures ranging between 75° and 90° F., but these temperatures should not be reached in practice, since they are also the temperature at which bacteria thrive best, and a lower temperature, whilst allowing the yeast-organism to perform its functions, considerably discourages the growth of disease ferments. The amount of yeast to be used depends upon its activity, the gravity of the wort, and the time of the year, but varies from about $\frac{3}{4}$ lb. to 3 lbs. of fairly solid yeast per barrel. It is usual to mix the yeast with a small quantity of the wort at a temperature of about 80° F. before adding it to the remainder of the wort in the fermenting vessel. The commencement of the fermentation is indicated by a line of small bubbles forming round the sides of the tun, and in a short time extending over the whole surface.

The yeast which now rises carries with it suspended matter derived from the hops, &c., and this is usually removed in order to prevent contamination of the subsequent yeast 'crop.' The head of yeast increases and exhibits a rocky appearance, whilst the temperature gradually rises. At the end of about 36 or 48 hours the rocky head breaks down and assumes a yeasty appearance, the colour becomes yellowish brown, and large bubbles of gas continually form. The wort will now have been reduced by about one half or one third of its original gravity, and the temperature will have risen to about 66° F. The tun is now skimmed every 5 or 6 hours, a slight layer of yeast always being allowed to remain to prevent access of air to the wort. The object of the skimming is not only to check the violence of the fermentation, but also to prevent the yeasty head from sinking, and so communicating a disagreeable bitter flavour to the beer ('yeast bite'). Throughout the process the temperature should not be allowed to exceed 72° F., any tendency to rise above this being checked by the judicious use of the attemperator or skimming. English beers are usually attenuated to about one fourth or one sixth of the original gravity, the fermentation process lasting about 6 days. A decrease of 4·3 degrees of gravity in this process corresponds to the formation of about 1% proof spirit (containing 49·24% absolute alcohol by weight). When the attenuation of the wort has stopped it is run into a settling-back, where it remains for about 12 hours, being then racked off into casks, the yeasty deposit remaining behind. Instead of the above system of skimming, the wort, at about half its original gravity, may be run into smaller vessels (cleansing rounds, casks, &c.), and the yeast formed during the remaining part of the fermentation allowed to work out at the top of the round or the bung-hole of the cask. In Burton, vessels known as 'unions' are employed for this purpose. The 'unions' are casks capable of containing 2 or 3 barrels of liquid, suspended on their axes and united together. The yeast formed is driven out through a long bent pipe termed a 'swan-neck' into the yeast trough. It may be regarded, as a rule, that the lower the temperature, the more regular and less interrupted the process of fermentation, the better will be the quality of the beer and the less the liability to change by age.

5. *Storing.* In brewing beer intended for export or storing the brewer should leave less unfermented matter in his beer than in other cases. A larger ratio of dextrin to maltose in the wort should be secured by shortening somewhat the period of standing-on the goods.

6. *Fining.* This process, which is carried out in the delivery cask, consists in artificially clarifying the beer by means of a solution of isinglass. It must be remembered that the fining action never takes place whilst fermentation is proceeding, and the beer must be in a quiescent condition. Finings were formerly made by dissolving isin-

glass in sour beer, but the use of finings so prepared amounts to an inoculation of the healthy beer with disease-ferments of all descriptions, and is now rarely met with.

A better method consists in dissolving the isinglass in sulphurous acid—about $1\frac{1}{2}$ galls. of sulphurous acid to 10 lbs. of finings. The mixture should be allowed to stand two or three days, and should be thoroughly stirred each day. Frequent additions of water, together with sufficient sulphurous acid to communicate a decided smell to the mixture, should be made and the stirring continued. At the end of about three weeks the mixture will have the consistency of a syrup. The finings should be strained and brushed through a fine hair-sieve and diluted to about three barrels. Of this solution about $1\frac{1}{2}$ pints per barrel of beer will be required. After the addition of the finings the beer is well shaken and left lying for the sediment to settle.

Gen. Commentary. The preceding is a concise account of all the essential operations of the system of brewing at present practised in this country. On the large scale, extensive and costly apparatus and machinery are employed for the purpose. On the small scale, such modifications of the processes herein detailed are adopted as the circumstances of the brewer may require. The principles underlying the brewing process are, however, essentially the same under all the conditions here referred to. In Scotland the mashing temperature is higher than in England. In the old Scotch system of fermentation the wort was pitched with a small quantity of yeast at as low a temperature as 55° F., the process lasting longer, and the yeast being stimulated by frequent 'rousings.' In the modern system the process lasts for about 6 or 7 days. The slow and regular fermentation at low temperatures, followed in the old system, has very much to recommend it, the length of time required constituting a serious disadvantage. In Germany two systems chiefly are in use, viz. the Lautermaisch (thin mash) and the Dickmaisch (thick mash).

In the Lautermaisch process the grist is first thrown into the tun. Water at a temperature of 176° F. is then run under the plates, and after standing for some time the rakes are set in motion and mashing continued for another half-hour, after which tap is set and the wort run into the copper. So soon as the wort commences to run off bright it is turned into the under-back. The thick wort in the copper is then boiled for 75 minutes, after which it is returned to the mash-tun, part of it being admitted below the plates and part of it being run on the top of the goods. The whole is then allowed to stand whilst the bright wort in the underback is pumped into the copper and boiled. In the Dickmaisch process the ground malt is mixed in the mash tun with cold water and allowed to stand for about $1\frac{1}{2}$ hours. Sufficient hot water is then run into the mash to raise the temperature to 100° F. One fourth of the mash is now pumped into the copper and boiled, after which it is returned to the tun, raising the temperature of the entire mash to about 122° F. The second Dickmaish is then transferred to the copper and boiled for about one hour, at the end of which time it is run into the tun, raising the temperature to 140° F. The mash is now allowed to stand for $\frac{1}{4}$ hour, after which tap is set and the Lautermaisch run into the copper and boiled for $\frac{1}{4}$ hour, being then returned to the tun, the temperature being again raised to about 167° F. The mash is now allowed to stand for about $1\frac{1}{2}$ hours, after which tap is set. The yeast employed in the fermentation-process is bottom yeast. The wort is pitched at a temperature of from 39°—42° F. The process lasts about 12 or 15 days, the temperature never being allowed to rise above 44° F. At the end of this time the wort will have attenuated to one half its original gravity, and is then racked off into casks, which are placed in cellars and surrounded with ice. Here the secondary fermentation goes on slowly during some months. The amount of hops used by the German brewer is much less than is used in England. For running ales about 4 lbs. per qr. of malt is the quantity, and in a highly-hopped Bavarian beer there would not be more than 7 lbs. Speaking of the use of hops, Dr Graham says: "Hops contain narcotic substances; indeed formerly, and now sometimes, hops were used in place of opium to produce sleep, and not only do we use far too much in our ales, but we also gather our hops too late. In Bohemia and Bavaria the hops are gathered before the strobiles open and before the seed forms, and this is done in order to avoid too much of the narcotic substances, which increase with the formation and ripening of the seed."

The sugar materials used in brewing may be classed under three heads:

1. Glucose (Dextrose).
2. Invert sugar.
3. Cane-sugar.

The sugar in the solid state or in solution is usually added in the copper, but sometimes in the hop-back. Of these two methods the former is much to be preferred, as not only is a more thorough admixture obtained, but the continued boiling in the copper lessens the danger to be feared from nitrogenous matter and other impurities in the sugar. It must be remembered that cane-sugar is not directly fermentable; but is converted, by means of a soluble albuminous substance contained in yeast, into invert sugar. The use of cane-sugar in quantity tends to weaken the yeast, and should always be inverted (*i. e.* converted into invert sugar by boiling with dilute acid) prior to use. This operation of inversion should not be undertaken without advice from some competent authority, and it is better to purchase the ready-prepared article. Whether glucose or invert sugar should be used will depend on the class of beer to be brewed. Dextrose is only half as sweet as cane-sugar, whilst lævulose has the same sweetening power. When invert sugar (a mixture of equal proportions of dextrose and lævulose) is used in brewing, the dextrose undergoes fermentation first, so that the sugar remaining in the beer after fermentation will consist principally of lævulose, and the beer will consequently exhibit sweetness. If, on the other hand, a dry alcoholic beer is required, glucose should be used in its preparation. Another substitute for malt which has of late years attracted considerable attention is raw grain. Malt con-

tains much more diastase than is necessary for the saccharification of the starch contained in it, and consequently, if an admixture of malted and unmalted (raw) grain be made, the whole of the starch will be converted into maltose and dextrin. The saccharification may be carried out either in a separate vessel or in the mash-tun itself. According to one method the raw grain is mixed with about 10% of the weight of malt and 2 barrels per quarter of water at a temperature of 140°—160° F., and the temperature is gradually raised to the boiling-point and kept there for a few minutes in order to burst the starch-granules, and so facilitate the action of the diastase. The mixture is then cooled down to about 155° F. and the remaining malt added, a thorough mixture being made by means of the rakes. This will give an initial heat of about 148° F. This use of raw grain tends to increase the dextrin ratio in the wort; so that to produce an alcoholic beer a lower mashing heat and longer time of standing-on must be resorted to. Since raw grain contains more starch than malt, there will always be a higher extract than when malt alone is used.

Mr T. W. Lovibond gives the following numbers, showing the relative costs of 1 lb. of extract from various materials:

	Oats.	Maize.	Rice.	Barley.	Prepared Rice.	Malt.
Pence per lb.	3·3	2·9	3·0	3·6	4·5	6·0

One quarter of malt yields from 85 to 89 lbs. per barrel soluble extract, the standard yield of the excise being 4 barrels at 1057° gravity or 1 barrel of 82·08 lbs.

The following rules for converting 'lbs. per barrel' into degrees of sp. gr. and *vice versâ* will be of use:

1. To convert degrees of sp. gr. into 'lbs. per barrel:'

   Subtract 1000 and multiply the remainder by 0·36.

Example. Convert 1125° sp. gr. into 'lbs. per barrel:'

$1125-1000=125\times\cdot35=45$ lbs. per barrel.

2. To convert 'lbs. per barrel' into degrees of sp. gr.:

   Divide by 0·36 and add 1000 to the result.

Example. Convert 12·6 'lbs. per barrel' into degrees of sp. gr.:

$12{\cdot}6\div\cdot36=35+1000=1035°$.

English proof spirit has, at 60° F., a sp. gr. of ·91984. It contains by volume 57·06% absolute alcohol and 49·24% by weight. The approximate percentage of cane-sugar in a sample, together with its extract, may be found by taking the sp. gr. of a 10% solution and then making use of the following factors:

Subtract 1000 from the sp. gr. of a 10% solution, and divide the remainder by 0·386.

Example. Sp. gr. of a 10% solution = 1037·9°.
$1037{\cdot}9-1000=37{\cdot}9\div\cdot386=98{\cdot}18\%$ cane.

To obtain the extract, multiply the percentage of cane by 0·864.

Example. $98{\cdot}18\times\cdot864=84{\cdot}82$ lbs. extract.

The percentage of cane × 0·93 gives the extract that a sample of cane-sugar would give after having been converted into invert sugar.

Exportation of Beer. When beer is exported from any part of the United Kingdom, either as merchandise or ships' stores, the brewer or exporter of such beer is allowed a certain 'drawback' of duty. This drawback is at the rate of 6*s.* 3*d.* for every 36 galls. at 1057°, and so in proportion on the quantity, as the original gravity may be higher or lower.

Brewing Utensils. The great necessity for perfect cleanliness in all tuns, casks, and other utensils used in the brewing process, cannot be too strongly insisted upon. A thorough scrubbing with boiling water and steaming will usually be sufficient, but in some cases treatment with chloride of lime and bisulphite of lime may be necessary. It is advisable, after washing out fermenting tuns and vats as usual, to mop them over internally with bisulphite of lime previous to using them. This will prevent the growth of disease-organisms and keep the vessels sweet.

BRICKS. Brick-making scarcely comes within the province of this work. In connection with hygiene, however, we may call the reader's attention to the superior advantages of both hollow and waterproof bricks: the first, for ventilation and lightness; the last, for preserving the dryness and integrity of our homes under all the vicissitudes of climate, season, and weather, either on damp soils or dry ones. Workman's 'Patent Waterproof Bricks' received a strong commendatory notice from the Commissioners of the 'Great International Exhibition' of 1851.

The quality of brick used for building purposes is a matter of great importance, and one which affects the householder perhaps more than he is aware of. As with other articles, good bricks are not cheap; and the modern builder is but too often guided entirely by the question of profit in the choice of material, and especially bricks and mortar, the cheapest quality and the smallest quantity which will satisfy the requirements of the Local Board being used. Even the best bricks are porous and absorbent, and an average brick will hold 16 oz. of water, inferior qualities much more. An excellent test of a brick is to bake it until it ceases to lose weight, *i.e.* until all the water has been driven out; then immerse it in water for some time, wipe the outside dry with a cloth, and weigh. The increase in weight represents the water taken up, and the less the quantity the better the brick. When it is remembered that the walls of a house are set deep in the soil, and that they are built of materials capable of absorbing water to this extent, and further, that capillary attraction will assist in, as it were, pumping the water out of the soil, it will be obvious that it is of importance to use material which possesses as small a water-holding capacity as possible. This is further to be prevented by the insertion, at a few inches above the ground, of a proper *damp course, i.e.* one or two layers of brick set in cement and covered with slates set in tar, thus fixing the limit to which the water sucked up from the soil shall rise, and saving the householder the intolerable annoyance and unhealthiness of damp walls. The side of a house exposed to the prevailing winds and rain, if faced with inferior and very porous brick, will hold an enormous quantity of water, the greater part of which would be turned off by good

material. Good bricks, and above all good mortar *well pointed*, are, therefore, of very great importance in securing a healthy house. Some other and little known properties of brick will be mentioned under VENTILATION.

BRILLIANTINE. *Prep.* 1. Castor oil, 1 part; eau de Cologne, 4 parts. Mix.

2. Honey, 1 *oz.;* glycerine, ½ *oz.;* eau de Cologne, ½ *oz.;* spirit of wine, 2 *oz.* Mix.

3. Glycerine, 1 part; castor oil, 3 parts; absolute alcohol, 60 parts. Perfume to taste.

4. It is customary in the West End of London to keep a separable and a non-separable preparation; the latter is usually prepared by dissolving absolute alcohol in an equal quantity of castor oil and perfuming; the perfume generally consists of heliotrope (or any other spirituous perfume), 3 dr., and almond oil to 2 oz. The following make a good separable brilliantine:

Ol. jonquill.	ʒv.
Ol. jasmin.	ʒv.
Ol. amygd.	℥ij.
S.V.R. ad	℥iv.

BRINE (for Meat). *Prep.* 1. A nearly saturated solution of common salt, 1 lb.; and saltpetre, 2 oz.; in soft water.

2. To the last add of sugar or treacle, ½ lb. Bay-salt is recommended when the meat is to be kept for a very long period. Meat preserved in brine that has been used for curing several times is said to become poisonous. See PICKLING, &c.

Brine, Red Cabbage. Red cabbage leaves steeped in a strong solution of common salt. Used as a test for acids and alkalies.

Brine, Vi′olet. From the petals of the blue violet, as the last. Used as a test for acids.

BRINJAL, or AUBERGINE (*Solanum melongena*, Linn.). A plant largely cultivated in hot countries. The fruits, which are more or less egg-shaped, vary considerably in size and colour, being either white, yellow, violet, purple, or nearly black. They are very highly esteemed in France, and are sometimes seen in the markets in this country.

BRIOCHE PASTE (bre-ōsh′). In *cookery*, a species of paste, or crust, prepared of eggs and flour, fermented with yeast, to which a little salt, a large quantity of sugar, and about half as much butter as the weight of the flour used, are afterwards added, and well worked in. Used as an addition to soup, and as a casing for lobsters, patties, eggs, &c.

BRISK′NESS. The natural briskness and sparkling of fermented liquors depends on the gradual evolution of carbonic acid gas within the body of the fluid, by the process of fermentation. See MALT LIQUORS, PORTER, WINES, &c.

BRISTLES (brĭs′lz). The stiff hair of swine, &c. They are commonly stiffened by immersion for a short time in alum-water, and are dyed by steeping them for a short time in any of the common dyes used for cotton or wool.

BRITAN′NIA METAL. An alloy of tin and antimony, frequently containing in addition small quantities of copper, lead, and zinc, and sometimes bismuth; ashberry, minofor, and English metals are varieties of it. It is prepared by first melting the copper by itself, and then adding to it a portion of the tin and all the antimony; the last quantity of the tin is finally added, and the alloy is stirred for some time to make it homogeneous. Britannia metal may be brought into any desired shape by pressing or rolling, but as it is somewhat brittle, it is preferred to make many articles by direct casting, for which purpose brass moulds are the best to use. In either case the metal has an unsightly grey-white appearance, and has to be brightened by polishing, or coated with silver by means of electricity. Britannia metal has a silvery colour with a bluish tinge, and takes a fine polish, which it retains on exposure to the air. It is hard, but in strength only slightly surpasses tin. Good metal shows a fine-grained, jagged fracture; if the fracture be quite coarse and strongly crystalline the alloy contains too much antimony, and is too brittle to be worked to advantage. Britannia metal is always brittle, but especially so when it contains iron or zinc; these metals must therefore be absent if the alloy is to be rolled or stamped. Copper makes the alloy more ductile, but at the same time less fusible, and lead makes it more fusible and causes it to fill out the moulds better, but both of these metals injure the colour. Perhaps the best composition is tin, 90 parts, and antimony, 10 parts. For most purposes where a special degree of hardness is not required this alloy is the most suitable, it being readily fusible, and filling out the moulds well. For articles subjected to constant wear, a harder alloy is required. The composition of some varieties of Britannia metal is given below:

	Tin.	Antimony.	Copper.	Zinc.	Lead.	Bismuth.
English	81·9	16·2	1·8	—	—	—
”	90·6	7·8	1·5	—	—	—
”	90·1	6·3	3·1	5	—	—
”	85·4	9·7	0·8	3·1	—	—
Pewter	81·2	5·7	1·6	—	1·1	—
”	89·3	7·6	1·8	—	1·8	—
”	83·3	6·6	1·6	3·1	—	1·6
Tutania	91·4	—	0·7	0·3	7 6	—
Queen's metal	88·5	7·1	3·5	0·9	—	—
German	72	24	4	—	—	—
”	84	9	2	5	—	—
” (cast)	20	64	10	6	—	—
Malleable (cast)	48	—	3	48	—	1
Birmingham (sheet)	90·6	7·8	1·5	—	—	—
” (cast)	90·7	9·2	0·1	—	—	—
Karmarsch's	85	5	3·6	1·4	—	1·6
Kœller's	85·7	10·4	1	—	—	1·8
Wagner's (fine)	85·6	9·7	0·8	3·1	—	0·8

BRITANNIA SILVER. A variety of silver-plated Britannia metal, once sold at Vienna, and probably elsewhere, in the form of cups, spoons, forks, candlesticks, &c., with the misleading assurance that it was a perfect substitute for silver. One firm even sold cups of tinned Bessemer steel-plate as guaranteed Britannia silver.

BRITISH GUM. DEXTRIN (which *see*).

BROC'COLI. [Eng., L., Ger.] *Syn.* BROCOLI, Fr.; BROCCOLO, It. A well-known sub-variety of cauliflower. The qualities, and the mode of dressing broccoli, are similar to those of cabbages, noticed elsewhere. See VEGETABLES (Culinary), &c.

BROKEN KNEES (in Horses). The wound should first be thoroughly washed, and then sewn up and fomented with tepid water. Afterwards cold-water dressings containing a little carbolic acid may be applied. Perfect rest is essential, and, where necessary, splints and slings must be had recourse to. After the wound has thoroughly healed blisters are recommended for restoring the hair.

BROKEN WIND (in Horses). The common name for asthma defined by Williams as "a non-inflammatory disease, characterised by difficult and peculiar breathing; the inspiratory movement is performed with ease, the expiratory by two apparent efforts. The difficulty in breathing is constant, but is liable to remissions and severe exacerbations. A peculiar cough, called 'the broken-winded cough,' is a constant symptom; indigestion and flatulence aggravate the dyspnœa."

The precise cause of 'broken wind' has long been a matter of dispute among veterinary surgeons. The disease appears to be a variety of asthma, accompanied frequently by emphysema of the lung, and probably due to irregular action of the pneumogastric nerves, which is, in the opinion of many competent authorities, brought about by improper feeding and overloading of the animal's stomach, the use of too much dry food, "bad, musty, or coarse hay, containing a large quantity of woody fibre from being allowed to become too ripe before being cut, and to a superabundance of hay of any kind, with a deficient supply of corn" (*Williams*).

Treatm. Great attention to diet. Care should be taken that the food is of the best quality and given in moderate quantity. Occasional purgatives are useful, and the bowels should always be kept in good order.

The following quotation from Prof. Williams' book may prove of service to those who have to deal with horses:—"'Horse-coupers' resort to various methods for relieving the breathing of broken-winded horses. These persons know well enough that the animal breathes moderately well when the stomach is empty; they therefore take good care to keep it short both of food and water, and give it a sharp trot to unload the bowels. Shot, lard, gunpowder, opium, and other remedies are then poured down its unoffending throat, and most of these remedies seem to exercise a sedative or stilling effect, and the unwary purchaser only knows too late how cleverly he has been 'sold.'"

BRO'MA. *Prep.* 1. Pure cocoa, 1 lb.; sugar and sago-meal, of each, 4 oz.; mix. British arrowroot (*i.e.* carefully prepared potato-starch) is often substituted for the sago.

2. As the last, but using fine wheat-flour in lieu of sago-meal. Made into a beverage in a similar way to cocoa.

BROMAL. $C_2HBr_3O = CBr_3CHO$. *Prep.* By passing bromine vapour into alcohol, distilling the product, and adding water to the fraction which comes over between 165° and 180° C. (329° and 356° F.); bromal hydrate is thus formed and is re-crystallised from water, and the bromal obtained from it by means of sulphuric acid.—*Prop.* It is an oily liquid, with a pungent smell and sharp burning taste, and boiling at 174° C. (345° F.); sp. gr. 3·34; like chloral it forms a solid hydrate with water. Its powerful irritant properties prevent its use as an anæsthetic.

BROMIDE. *Syn.* BROMIDUM, L.; BROMURE, Fr.; BROMID, Ger. A salt of hydrobromic acid.—*Prop.* The bromides are mostly white, and, with the exception of those of the heavy metals, they are soluble in water. They are decomposed by chlorine, which forms a chloride and sets free the bromine; the bromine is also liberated by oxidising agents.

Tests for. Solutions of bromides give with silver nitrate a yellowish-white precipitate, insoluble in nitric acid, but dissolving, though somewhat slowly, in strong ammonia; with mercurous nitrate they give a yellowish white precipitate, insoluble in nitric acid. When shaken up with a little chlorine water bromine is liberated, and colours the solution yellow; if a few drops of chloroform or carbon disulphide be now added, and the whole again shaken up, the bromine will dissolve in the chloroform, &c., forming a yellowish-brown solution which sinks to the bottom of the vessel; ether may also be used, in which case the brown solution obtained floats on the rest of the liquid. These solutions may be decolorised by agitation with a large excess of chlorine water. (For individual bromides, see their respective bases.)

BROMIDIA. An American nostrum said to contain 15 gr. potassium bromide, 15 gr. chloral hydrate, with $\frac{1}{8}$ gr. each of extracts of Indian hemp and henbane in each fl. dr.

BROMINE. Br. Atomic weight = 80. *Syn.* BROMUM, L.; BROME, Fr.; BROM, Ger. A non-metallic element belonging to the same group as fluorine, chlorine, and iodine, all of which it strongly resembles in its chemical properties.

Sources. It never occurs free, but always in combination; as *bromides* of sodium, potassium, magnesium, and calcium it is found in sea-water, in the ashes of many seaweeds, in the water of mineral springs in Germany and America, and in the residual liquor obtained in the manufacture of potassium chloride and sulphate at Stassfürth in Germany.

Prep. 1. (Used on the small scale.) The mother-liquor containing the bromides is evaporated down, when the less soluble salts, chiefly chlorides and sulphates, separate out. Chlorine gas is now passed into the residual mother-liquor (which in the case of sea-water is called *bittern*), care being taken to avoid an excess of chlorine. The chlorine displaces the bromine from the bromides, forming chlorides, and by shaking up

the solution with ether or chloroform the liberated bromine is obtained in solution in either of these. This solution is separated from the rest of the liquid, and caustic potash is added; the brown colour rapidly disappears, bromide and bromate of potassium being formed. The liquid is now evaporated to drive off the ether or chloroform, and the concentrated solution is heated with manganese dioxide and sulphuric acid in a tubulated retort, when the bromine distils over, and is collected in a cooled receiver. If iodine is present it must be got rid of by precipitating it as cuprous iodide, and any water present may be removed by distilling the bromine over strong sulphuric acid.

2. On the large scale, the mother-liquor containing the bromides is mixed with sulphuric or hydrochloric acid in a stone vat, and treated with such a quantity of black oxide of manganese as will not evolve more chlorine than is needed to liberate the bromine; the vats are heated by passing steam into them, and the bromine which distils off is condensed in earthenware worms. In order to separate the bromine from the more volatile chloride of bromine formed at the same time, the vapours are not perfectly cooled; the bromine then collects in the receiver, and the more volatile chlorine compound passes on, and is absorbed in caustic soda. The impure bromine in the receiver is purified by repeated fractional distillations; most of the chlorine and the less volatile organic bromides are thus separated, and the last traces of chlorine may be removed by distillation over potassium bromide. If the liquors used in this process also contain iodides, the iodine is first liberated by a limited addition of manganese dioxide, and the bromine afterwards set free.

The quantity of bromine produced in Stassfürth in 1873 amounted to 20,000 kilos., whilst England and France produced about a like amount, and America contributed in 1870 no less than 62,500 kilos.

Prop. Bromine is a heavy mobile liquid of a dark brown-red colour, opaque in all but thin layers. It possesses a most irritating odour similar to that of chlorine and iodine, hence its name, from the Greek word *bromos*, a stench. Its vapour is red, and produces great irritation when inhaled, as it attacks the mucous membrane; it also affects the eyes very painfully. The liquid acts on the skin, colouring it a brownish yellow and producing a corrosive sore which is very difficult to heal. Bromine solidifies at $-7°$ C. (19° F.), boils at 59° C. (138° F.), and has a sp. gr. of 3·187. It is slightly soluble in water, but much more so in carbon disulphide, chloroform, ether, and alcohol. Bromine water possesses bleaching properties similar to but less powerful than those of chlorine. It unites, though with difficulty, with hydrogen to form *hydrobromic acid*, and in combination with metallic elements it forms *bromides*, a class of salts which much resembles the fluorides, chlorides, and iodides.

Tests for and Purity of. Bromine is easily recognised by its colour, odour, and volatility, and by the colour of its vapour. Its chief impurities are chlorine, iodine, and bromide of carbon. Chlorine may be detected by adding some of the bromine to a solution of potash, evaporating, drying the residue, and distilling it with some solid bichromate of potash and strong sulphuric acid; if chlorine is present, red vapours of chromium oxychloride (CrO_2Cl_2) will distil over and condense to a red liquid, which gives with potash or ammonia a yellow solution. (Bromine and iodine do not yield analogous compounds; when bromides and iodides are distilled along with potassium bichromate and strong sulphuric acid, free bromine and iodine are evolved, and these yield of course a *colourless* solution with potash or ammonia.) Iodine may be detected by adding bromine to a solution of soda little by little, with repeated agitation, till a slight permanent colour is obtained; solution of starch is now added, and if iodine is present, a deep blue coloration is produced. Bromide of carbon has a higher boiling-point than bromine, and may be separated from the latter by fractional distillation.

Estim. Bromine is estimated in its compounds by dissolving them in water, acidifying the solution with nitric acid, and adding excess of silver nitrate. The precipitated silver bromide is then collected, washed and dried, and finally heated till it begins to fuse, and weighed when cold. Its weight multiplied by 0·574 gives the weight of bromine which it contains.

Uses, &c. Bromine possesses very similar medicinal properties to iodine, and has been administered in goitre, scrofula, &c., in the form of an aqueous solution composed of 1 part of bromine to 40 of water, of which 5 or 6 drops is the dose; but it is more usually given under the form of bromide of potassium (which *see*). The compounds of bromine are also largely used in photography in the manufacture of certain coal-tar colours, and in scientific chemistry the solution has also been used as a lotion. Bromine is a good disinfectant. It is very poisonous; the antidotes, &c., resemble those for iodine. See BROMIDE, SOLUTIONS, &c.

BROMOCHLORALUM (*Tilden & Co.*, New York), for the removal of bad smells, as a disinfectant, and antiseptic. A fluid, sp. gr. 1·43, containing 27·5% of solid matter. The latter consists of 18·5% of aluminium chloride, with chalk and a considerable quantity of alkaline salts. Free bromine is not present (*H. Endemann*).

BROMOFORM. $CHBr_3$. A colourless liquid, obtained by distilling bromide of calcium with alcohol. It has a sp. gr. of 2·90, and boils at 305·6° F., emitting a vapour having a density 8·632. It is somewhat similar in properties to chloroform, but much more irritating; hence it has been rarely employed medicinally.

BROMTHEE—BRAMBLE TEA (?)—is a mixture of 5 parts lime flowers *cum bracteis*, 5 parts senna leaves, 5 parts acacia flowers, 8 parts cort. frangulæ, and 2 parts sassafras chips (*Hager*).

BRONCHI′TIS (brong-kī′-). [L.; prim. Gr.] In *pathology*, inflammation of the mucous lining of the bronchi or smaller ramifications of the windpipe. In its milder form it is popularly called a 'cold in the chest.'

Symp. The usual symptoms are hoarseness, dry cough, and a slight degree of fever, followed by expectoration of mucus, at first thin, and afterwards thick and copious. In the severer

forms there is more fever, cough, and oppression at the chest, &c.

Treatm. It generally yields to small and repeated doses of ipecacuanha and antimonial diaphoretics; a light diet and mild purgatives being at the same time adopted, but in every case it is safer to have recourse to medical aid.

A warm moist atmosphere is peculiarly grateful to persons suffering from chronic bronchitis; a kettle with a long spout projecting into the room, kept simmering on the fire, is a simple means of effecting this saturation of the air with moisture. Bronchitic patients should be most careful of their diet, and eat nothing which tends to cause dyspepsia, as this will often provoke or aggravate an attack; they should avoid changes of temperature, and wear woollen underclothing winter and summer, and take all such means as will tend to maintain their general health.

HORSES. Finlay Dun prescribes the following: Tincture of aconite, inhalation of the vapour of water, ether, and belladonna, carbolic acid, sulphurous acid, mash diet, salines, chlorate of potash, the salts of ammonia, chloral hydrate, mustard externally, warm clothing, but cool air. Symptoms very similar to those of bronchitis are frequently caused in calves and young cattle by the presence in the bronchi of threadworms or filaria. The cause is generally removed by the administration of a dose or two of oil of turpentine, given at intervals of a day or two.

BRON′CHOCELE (brong′-ko-sēle). See GOITRE.

BRONZE. [Eng., Fr., Ger.] *Syn.* ÆS, L.; BRONZO, It. An alloy of tin and copper, remarkable for the exactness of the impressions which it takes by moulding and stamping, as well as for its great durability. It has hence been always extensively employed in the casting of busts, medals, statues, &c. In ancient times, when the manufacture of steel was ill-understood, cutting instruments were commonly made of it. It was also the general material of coins of small value; a use which, of late years, has been revived in several of the states of Europe, and still more recently in the coinage of these realms. Bell-metal, gun-metal, and speculum-metal are mere varieties of bronze.

Prep. On the small scale this alloy is prepared in crucibles; but for statues and larger works on reverberatory hearths. The fusion of the mixed metals is conducted as rapidly as possible under pounded charcoal, and the melted mass is frequently stirred together to produce a perfect mixture before casting.

The proportions of the materials so vary in different castings that it is almost impossible to say precisely what quantities are the best. The following are given as examples:

a. For EDGE-TOOLS. Copper, 100 parts; tin, 14 parts. When skilfully hardened and tempered this alloy is capable of receiving an edge nearly equal to that of steel.

b. For GILDING. 1. Copper, 82 parts; zinc, 18 parts; tin, 3 parts; lead, 2 parts.

2. From copper, 83 parts; zinc, 17 parts; tin, 2 parts; lead, 1 part.

c. For MEDALS. 1. Copper, 89 parts; tin, 8 parts; zinc, 3 parts. This alloy assumes a beautiful antique appearance by age, and takes a sharp impression by stamping.

2. (*M. Chaudet.*) Copper, 95 parts; tin, 4 or 5 parts. This is also excellent for any small castings.

d. For MORTARS. Copper, 95 parts; lead, 5 parts; tin, 2 parts.

e. For STATUARY. 1. Copper, 88 parts; tin, 9 parts; zinc, 2 parts; lead, 1 part.

2. Copper, 82½ parts; zinc, 10½ parts; tin, 5 parts; lead, 2 parts. These are very nearly the proportions of the metal in the celebrated statue of Louis XV.

3. Copper, 90 parts; tin, 9 parts; lead, 1 part.

4. Copper, 91 parts; tin, 9 parts.

For a gold varnish for bronze objects refer to BRASS.

Obs. Several analyses have been made of ancient cutting instruments, from which it appears that the proportion of tin varies from 4% to 15%; a fact which tends to prove that more depends upon the exact mode of tempering the alloy than on the relative proportions of the ingredients. Lead and zinc are inadmissible in bronze for this purpose. 1% or 2% of iron may, nevertheless, be added with advantage. The ancient bronze used for springs contained only 3% to 4% of tin. The edges and lips of bronze mortars must be carefully tempered by heating them to a cherry red, and then plunging them into cold water, as unless so treated they are very apt to be broken in use. See BELL-METAL, BRASS, GUN-METAL, &c.

Bronze′-powder. *Syn.* BRONZE. A name given to various powders having a rich metallic appearance, which they retain when applied on varnish, or when mixed with it, as in surface bronzing.

Prep. 1. GOLD-COLOURED. *a.* From Dutch-foil, reduced to an impalpable powder by grinding. Cheap and looks well, and is very durable when varnished.

b. From gold-leaf, as the last.

c. Precipitated powder of gold.

d. From verdigris, 8 oz.; tutty powder, 4 oz.; borax and nitre, of each, 2 oz.; bichloride of mercury, ¼ oz.; grind them together, make the mixture into a paste with oil, and then fuse it; when cold, roll it into thin sheets or leaves, and grind it as in No. 1.

2. IRON-COLOURED. Plumbago, in fine powder.

3. RED. Sulphate of copper, 100 parts; carbonate of soda, 60 parts; mix, and apply heat until they unite into a mass; then cool, powder, and add of copper filings, 15 parts; again well mix, and keep the compound at a white heat for about twenty minutes; lastly, when cold, reduce the 'residuum' to an impalpable powder, wash it in pure water, and dry it.

4. SILVER. Bismuth and tin, of each, 1 oz.; melt them together, and add of quicksilver, 1 to to 1½ oz.; when cold, powder it.

Obs. The above are used by painters, japanners, &c. See BISULPHIDE OF TIN (TIN), POWDERS, &c.

Bronzes, to Clean. Weak soapsuds or very dilute liquor ammoniæ will clean the dirt out of the fine lines of bronze statuary or ornaments.

Bronze statues, &c., exposed to air, smoke,

and dust, may be cleaned with a concentrated solution of carbonate of ammonia. This forms a 'patina' which resists the weather.

Magnus's process consists in rubbing the surface at intervals of several weeks with a mixture of glacial acetic acid, 20 parts; and neat's-foot oil, 100 parts. This produces a thin green coating which resists the weather well.

BRONZ'ING. The process of giving a bronze-like or an antique metal appearance to the surface of copper, brass, and other metals. The following methods are recommended for this purpose:

1. To the surface of the article, first thoroughly cleaned and polished, evenly apply with a brush the common crocus powder ('jewellers' rouge'), previously made into a smooth paste with water. When dry, place it in an iron ladle, or on a common fire-shovel, and expose it over a clear fire for about one minute; lastly, when sufficiently cold, polish it with a plate-brush. This gives a very rich appearance, similar to that on tea-urns; the shade depending on the duration and the degree of heat employed.

2. As the last, but substituting finely powdered plumbago for crocus powder. Equally beautiful, but deeper coloured and more permanent than that produced by No. 1.

3. As the preceding, but employing mixtures of plumbago and crocus in various proportions according to the shade desired.

4. A dilute solution of liver of sulphur (potassium sulphide) or of hydrosulphate of ammonia is applied with a camel-hair pencil to the metal previously slightly warmed; when dry, the surface is either left rough or brushed off. If liver of sulphur has been used, it will be better to wash it first in clean hot water, but without the slightest friction. This gives the appearance of very antique bronze.

5. Verdigris, 2 oz., and sal-ammoniac, 1 oz., are dissolved in vinegar, 1 pint; and the mixture is diluted with water until it tastes only slightly metallic, when it is boiled for a few minutes, and filtered for use. Copper medals, &c. (thoroughly clean) are steeped in the liquor at the boiling-point until the desired effect is produced. Care must be taken not to keep them in it too long. When taken out they are carefully washed in hot water, and dried. Effect as the last.

6. Verdigris and vermilion, of each, 2 oz.; alum and sal-ammoniac, of each, 5 oz. (all in fine powder); vinegar, q. s. to form a thin paste. This is spread over the surface of the copper, which is then uniformly warmed by the fire, and afterwards well washed and dried. The tint may be deepened by repeating the process. The addition of a little blue vitriol inclines the colour to a chestnut-brown, and a little borax to a yellowish-brown. Used by the Chinese for copper tea-urns, &c.

7. Sal-ammoniac, 1 oz.; cream of tartar, 3 oz.; common salt, 3 oz.; hot water, 1 pint; dissolve; then add of nitrate of copper, 2 oz., dissolved in $\frac{1}{2}$ pint of water; mix well, and with it repeatedly moisten the article (placed in a damp situation) by means of a soft brush. Produces a very antique appearance.

8. Salt of sorrel, 1 oz.; sal-ammoniac, 3 oz.; distilled vinegar, 1 quart; dissolve. As the last. Much used for bronze figures.

9. A very weak solution of bichloride of platinum, applied with a hair pencil or by immersion. Used for binding screws, holders, and other small articles of copper and brass.

10. Sulphate of iron and sulphate of copper, of each, 1 oz.; water, 1 pint; dissolve; wash the surface of the articles with it; let them dry; then apply a solution of verdigris, 2 oz.; dissolved in strong vinegar, $\frac{1}{4}$ pint; when dry, polish them with a soft brush, and either some plumbago or colcothar. Used for tin castings.

11. The articles (properly cleaned) are either immersed in, or washed over, with a solution of sulphate of copper or of verdigris. In a short time they acquire a coating of pure metallic copper, and are then washed. This only answers with iron and steel goods. It is admirably suited for iron castings.

12. An antique appearance may be given to silver by either exposing it to the fumes of hydrosulphate of ammonia, or immersing it for a very short time in a solution of hydrosulphate of ammonia, or in dilute nitric acid.

13. Barium sulphide, BaS, has been employed by Mr A. Watt to give a warm bronze tint to clean copper articles. The solution employed was made with four or five grains of this salt to each fluid ounce of water. The articles to be bronzed are immersed in the solution, and allowed to remain in it until they acquire the desired tint. All the salts and solutions of barium are more or less poisonous.

Bronzing, Bronze Powder. In *lithography.* See LITHOGRAPHY.

Bronzing, Sur'face. A term commonly applied to the process of imparting a bronze-like or metallic appearance to the prominent portions of the surfaces of figures made of paper, wood, plaster of Paris, &c. It is effected by first giving them a coat of oil-varnish or size, and when this is nearly dried, applying, with a 'dabber' of cotton or a camel-hair pencil, any of the ordinary metallic bronze-powders before referred to. Sometimes the powder is placed in a little bag of muslin, and dusted over the surface. The articles should be afterwards varnished.

Paper is bronzed by mixing the bronze-powders up with a little weak gum-water, and burnishing the surface when dry and hard.

Electrotypes, to Bronze. *Green.* Steep the medal or figure in a strong solution of common salt, or sugar, or sal-ammoniac for a few days; wash in water, and allow to dry slowly; or suspend it over a vessel containing a small quantity of bleaching powder, and cover over. The length of time it is allowed to remain will determine the depth of colour.

Brown. Add four or five drops of nitric acid to a wine-glassful of water. The object is rubbed over with this gently and allowed to dry, and when dry subjected to a gradual and equal heat; the surface will be darkened in proportion to the heat applied.

Black. Wash the surface over with a little dilute solution of hydrosulphate of ammonia, and dry at a gentle heat.

BROOM, Swan River (*Comesperma scoparium*, Steetz). From a small knotty rootstock a quantity of slender twiggy branches arise, the whole

forming a natural broom, which has only to be cut to be ready for use.

Broom Ashes. From broom-stalks burnt. Formerly used as a diuretic in dropsy.

Broom, Salt of. Obtained by dissolving broom ashes in water, and filtering and evaporating the solution. It consists principally of potassium carbonate. It was formerly used in dropsy, and as an antacid, &c.

BROOM, Yellow. The common name of the plant *Cytisus scoparius.* A useful diuretic; of great service in dropsy. See DECOCTION.

BROOM-RAPE (Nat. Ord. OROBANCHACEÆ), characterised by parasitical habit, brown colour, and absence of other than mere scale-like leaves.

BROSSE DE CORAIL. [Fr.] The root of lucerne (*Medicago sativa*), cleaned, dried, and hammered at the end. Used as a tooth-brush.

BROTH. *Syn.* JUS (coctis carnibus), JUS'CULUM, L.; BOUILLON, JUS, Fr.; FLEISCHBRÜHE, Ger. In *cookery,* the liquor in which flesh has been boiled. Broth is distinguished from soup by its inferior strength and quantity of seasoning, &c. It contains much of the nutriment of the meat. We extract the following from Dr Letheby's work 'On Food:'

"A nutritious broth, containing the albumen of the meat or chicken, may be obtained by infusing a third of a pound of minced meat or chicken in 14 oz. of *cold* water, to which a few drops (4 or 5) of muriatic acid and a little salt (from 10 to 18 gr.) have been added. After digesting for an hour or so, it should be strained through a sieve, and the residue washed with 5 oz. of water, and pressed. The mixed liquids thus obtained will furnish about a pint of *cold extract of meat,* containing the whole of the soluble constituents of the meat (albumen, creatin, creatinin, &c.), and it may be drunk cold, or slightly warmed, the temperature not being raised above 100° F., for fear of coagulating the albumen."

Broth, Scotch. This, which is in very general use amongst the middle and working classes of Scotland, is made as follows:—Put into a pot 3 quarts of cold water along with a cupful of Scotch barley, and let it boil; add 2 lbs. of neck of mutton. Allow it to stew gently for an hour, skimming occasionally. Then add turnips cut in squares, and onions sliced, and carrots and turnips uncut. The half of a small cabbage chopped in moderately fine pieces may be put in instead of all these vegetables; and leeks may be used instead of onions. Stew the whole for an hour longer. The broth is now ready. Season with salt and serve in a tureen. The meat is served in a separate dish, with the uncut pieces of turnip and carrot and a little of the broth as gravy. Any meat may be employed in the same way. Broths and soups contain the greater part of the saline matter of the meat, the crystalline principles, viz. creatin and creatinin, some of the albumen and fat, and an amount of gelatin dependent upon the duration of the boiling process. They also contain nearly all the odorous matters of the meat. Cold water extracts from one sixth to one fourth of the solid ingredients of meat. The presence of a large quantity of highly nitrogenous crystalline principles in broths and soups accounts for their restorative powers. These, which are the *creatin* and *creatinin,* bear a close resemblance to the theine of tea and coffee, and the *theobromine* of cocoa, in their physiological effects.

Broth is contra-indicated for children at the breast, as it not unfrequently provokes sickness, disorders the bowels, and induces fever. The same applies to beef tea. When, however, broth and beef tea are used as clysters in such quantities that can be retained, they act most beneficially. See BOILING, SOUP, &c.

BROWN DYES. *Natural Colouring Matters.* The most important brown dye-stuff is catechu, a substance derived from species of Acacia, Areca, and Uncaria, growing in India. It is used for obtaining shades of brown, olive, drab, grey, and black on cotton. It is not much used for wool dyeing, but is extensively employed in producing black dyes on silk.

Application to Cotton. The cotton is worked for half to one hour at 80°—100° C. (176°—212° F.) in a solution containing 10—20 grms. of catechu per litre. The cotton is then squeezed, allowed to cool, worked at 60° C. (140° F.) in a bath containing 1—2 grms. of bichromate of potash per litre, and finally washed. If a darker shade is required, the cotton may be left in the catechu bath until it is cold; and a still deeper shade may be imparted by drying the cotton previous to immersing it in the bichromate bath. In the above processes the cotton first becomes charged with white catechuic acid or catechin, and this on immersing the fabric in the bichromate bath becomes oxidised to a brown colouring matter known as japanic acid.

Mordants by themselves have little effect in modifying the colour produced by catechu. Aluminium mordants give a yellower shade, and iron mordants a brownish- or greenish-grey. They may be applied in the form of cold solutions of 1°—4° Tw. (1·005—1·02 sp. gr.), either before or after the bichromate bath, which is followed by a bath of sodium phosphate or other fixing agent (see MORDANTS). A great variety of shades may be produced by using the above mordants, and adding at the same time suitable dye-stuffs, such as old fustic, logwood, or alizarine to the dye-bath. Light shades may be obtained by dyeing in the usual way with catechu, and then, after washing, immersing in a bath of one of the above dyes, the small amount of chromic oxide derived from the bichromate bath being sufficient to fix a little of the dye. The same effect may be produced by immersing the fabric, after passing through the catechu and bichromate baths, in a dilute solution of Bismarck brown or magenta, but colours so obtained are not so fast to light. Catechu is sometimes used in the form of 'prepared cutch.' This consists of a fused mixture of catechu and aluminium sulphate, and is said to possess a greater colouring power than ordinary catechu.

Application to Wool. As before stated, catechu is not largely used for dyeing wool, nevertheless it is capable of yielding very fast rich browns. The method is as follows:

Boil the wool for one to one and a half hours in 10% to 20% catechu, and then work for half an hour in a separate bath containing 2% to 4% of

copper sulphate, ferrous sulphate, or bichromate of potash.

Application to Silk. Catechu is principally used in silk dyeing for the purpose of adding weight in the production of blacks. (See BLACK DYES, LOGWOOD.)

For other natural brown dyes (yellowish browns, olives, &c.) see YELLOW DYES.

Artificial Colouring Matters. Phenylene brown. Tri-ansido-azo benzene hydrochloride,

$$C_6H_4.(NH_2),N = N,C_6H_3(NH_2)_2,2HCl.$$

This colouring matter is obtained by the action of nitrous acid on *m.*-phenyline-diamine, the base produced being afterwards dissolved in hydrochloric acid. It is known as Bismarck brown, Vesuvine, Casselle, Manchester brown, Cinnamon brown, &c. Bismarck brown G G and E E (L Cassella & Co.) are the pure products from chrylene-diamine and phenylene-diamine respectively.

Application to Cotton. Prepare the cotton with tannic acid and tartar emetic (see MORDANTS), and wash and dye in neutral bath at 50°—60° C. (112°—140° F.), adding the dye gradually. Light shades can be dyed without the use of a mordant. The shades are similar to those of catechu, but brighter. Bismarck brown is frequently used in conjunction with the latter dye (see *above*). A great variety of shades can be produced by combining it with other basic colouring matters, such as magenta, malachite green, &c.

Application to Wool. Dye in neutral bath containing 5% to 8% of colouring matter. Enter wool at 45° C. (113° F.), and heat gradually to 100° C. The addition of 8% to 10% of alum gives a redder shade.

Application to Silk. Dye in a weak soap-bath at 60° C. (140° F.), and brighten in a fresh bath slightly acidified with acetic or tartaric acid.

Mineral Colouring Matters. Manganese brown. The cotton is soaked with a solution of manganese chloride ($MnCl_2$), squeezed, and then either introduced into a solution of ammonia or passed through a bath of boiling caustic soda. The manganous hydrate, $Mn(HO)_2$, or MnO_1H_2O, thus produced is next converted into the brown hydrated manganese dioxide (MnO_2,H_2O) by exposing the fabric to air, or by passing it through a solution of bleaching powder. The fabric is then washed and dried. The precipitation and oxidation may be effected in one bath by using a mixed solution of caustic soda and sodium hypochlorite. It is essential that the caustic soda should be free from carbonate, otherwise manganous carbonate will be precipitated, which does not oxidise readily. This difficulty may be obviated by passing the cotton, after saturation with manganese chloride, through a bath of 500 grms. of bichromate of potash, 7 litres of ammonia, and 25 litres of water. An unstable chromate of manganese is produced, which decomposes spontaneously into manganese dioxide (MnO_2) and chromic oxide (Cr_2O_3). Manganese brown is very stable, both to light, alkalies, and acids.

BROWN'ING. In *cookery*, a fluid preparation used to colour and flavour gravies, soups, &c.

Prep. 1. Sugar, 4 oz., and butter, 1 oz., are melted in a frying-pan or ladle with about a tablespoonful of water, and the heat is continued until the whole has turned of a deep brown; the heat is then lowered a little, and some port wine (about 1 pint) is gradually poured in; the pan is now removed from the fire, and the mixture well stirred until the roasted sugar is entirely dissolved; it is then put into a bottle, and ½ oz. each of bruised pimento and black pepper, 5 or 6 shalots (cut small), a little mace and finely grated lemon-peel, and ¼ pint of mushroom catsup added. The bottle is shaken daily for a week, and the clear liquid, after 5 or 6 days' repose, decanted into another bottle. Rich flavoured, but expensive.

2. As the last, but using strong beer, or water, instead of wine. A glassful of spirit may be added after bottling it.

3. Sugar-colouring, 1 pint; salt, ¼ lb.; mushroom catsup, ½ pint; spice, q. s. Excellent for all ordinary purposes.

4. Lump sugar (powdered), 2½ lbs.; salad oil, ½ lb.; heat as before; then add, of port wine, 1 quart; Cape wine, 3 quarts; shalots, 6 oz.; mixed spice, 4 oz.; black pepper, 3 oz.; mace, 1 oz.; salt, 1 lb.; lemon juice, 1 pint; catsup, 1 quart; mix well.

5. Good spirit-colouring or sugar-colouring and mushroom catsup, of each, 1 gall.; Jamaica pepper, black pepper, and shalots, of each, 4 oz.; cloves, cassia, and mace, bruised, of each, ¾ oz.; boil in a covered vessel for 5 minutes; digest for 14 days, and strain.

6. Colouring, 3 pints; mushroom catsup, 1 pint; common salt, ¾ lb.; Chili vinegar (strongest), ½ pint; spice, q. s. Half a pint of British brandy or rum may be added.

Obs. The above are excellent additions to gravies, soups, &c.; and of themselves form most admirable sauces for fish, meat, and game.

Browning (for Gun-barrels). *Prep.* The following are current formulæ:

1. Blue vitriol, 4 oz.; tincture of chloride of iron, 2 oz.; water, 1 quart; dissolve, and add aquafortis and sweet spirit of nitre, of each, 1 oz.

2. Blue vitriol and sweet spirit of nitre, of each, 1 oz.; aquafortis, ½ oz.; water, 1 pint; as last.

3. Butter of antimony and sweet oil, equal parts; well shaken together. To be applied to the iron previously warmed.

Obs. The above fluids are rubbed on the barrel (previously well polished and cleaned off with whiting to remove the oil), and allowed to remain on for some hours, or until the next day, when they are rubbed off with a stiff brush. The process may be repeated if necessary. The barrel is next washed in water in which a little pearlash or soda has been dissolved, and afterwards well rinsed in clean water; it is then polished, either with the burnisher, or with a brush and beeswax. Sometimes a coat of tough shell-lac varnish is applied.

BRUCEA (-sh'ă). False cusparia (which *see*).

BRUCHBALSAM—RUPTURE BALSAM (*Dr Tänzer*). No. 1. Compound rosemary cerate, nutmeg cerate, red Johannis oil, yellow wax, of each, 1 part; fat, 5 parts. No. 2. Mixture of nutmeg cerate, 50 parts; tallow, butter, of each, 10 parts, melted and mixed with 25 parts strongest liquor potassæ. No. 3. Compound rosemary cerate, oil of bayberries, of each, 3 parts; nutmeg cerate, 4

parts; red Johannis oil, 6 parts; yellow wax, 3 parts; tincture of myrrh and tincture of aloes, of each, ½ part; tr. opii, ¼ part, melted and heated until the spirit has evaporated (*Hager*).

BRUCHE, ruptures cured without medicine, operation, or pain, by Lavedan, chemist. A pelotte containing in it zinc and copper plate on which a solution of the 'poudre electro-chimique' (common salt) is dropped (*Hager*).

BRUCHPFLASTER — RUPTURE PLASTER (*Krüsi Altherr*). A spread plaster, the mass consisting of 5 parts Burgundy pitch and 2 parts turpentine (*Walz* and *Hager*).

Bruchpflaster—Rupture Plaster (*Casper Menet*). Machine-made paper covered with thin gauze, and thinly spread with a mass of 9 parts wax, 3 parts turpentine, and 1 part elemi (*Hager*).

BRUCHSALBE—RUPTURE CERATE (*Gottlieb Sturznegger*, Herisau, Canton Appenzell). A mixture of 50 parts fat and 1 part oil of bayberries (*Hager*).

BRUCHUS PISI, Linn., **BRUCHUS GRANARIUS**, Linn. THE PEA AND BEAN BEETLES. In very many samples of peas and beans of all kinds there are some of the pulse which have tiny holes in them, with dark edges. If these pulse are split open with a knife it will be seen that the insides are more or less eaten away, scooped out as it were. In some cases, although there may be no holes in them, the pulse look unhealthy and not of a proper colour.

Upon opening these a maggot will be found which is evidently feeding upon the contents of the pulse. The best sorts of peas for podding grown by market gardeners, and for seedsmen by farmers, are frequently much injured in this way, and it has been noticed that the large and broad bean known as the Mazagan is often seriously affected. Winter beans are more liable to be attacked than those spring-sown. Foreign peas and beans are worse as a rule than those grown in this country.

Though the embryos of the pulse are most generally left intact by the larvæ or maggots within them, the vitality of the seeds must be greatly impaired; and the plants from them, if indeed they are able to produce these, will be weakly, inasmuch as the supply of starch stored within the cotyledons for the support of the embryo and the young plant is diminished, and the other essential functions of the cotyledon are materially impaired.

Samples of peas and beans have been observed in which from 25 % to 30 % of the pulse had holes in them, showing their former occupation by the larvæ of these beetles. Obviously there would be a serious loss of plants if these seeds were sown, and a serious diminution in food value if they were consumed by animals. These insects are very destructive in America and Canada, so that in some parts of the latter country peas and beans cannot be cultivated. Harris states that the pea beetle is supposed to be a native of the United States, and that it may have been introduced from there into England ('A Treatise on some of the Insects of New England which are Injurious to Vegetation,' by Thaddeus W. Harris, M D.).

Life History. The perfect pea beetle, *Bruchus pisi*, is about 2 lines, or 1-6th of an inch in length. It is of dark colour, nearly black, with light-coloured spots on the elytra. Its wings are fairly large. The elytra do not cover the abdomen. The bean beetle, *Bruchus granarius*, is rather smaller than the pea beetle and slightly different in colour, being of a more shiny black and without spots, or at least spots so pronounced, upon the elytra, which cover the abdomen more completely than those of the *Bruchus pisi*. The female beetles appear first in May, and deposit eggs in the blossoms of peas and beans as soon as they are formed. From these eggs small larvæ are hatched in a few days. These are without legs, of a dirty white colour, with black heads. They bore into the young peas and beans as they are developed, and live upon their substance. The larvæ change to pupæ in the autumn, and remain within the peas and beans until the next spring, when they come forth as beetles. In mild weather, and in some circumstances, they come forth much earlier.

Prevention. Peas and beans intended for seed should be most carefully examined, and rejected if the samples contain any holes in them. In cases where it is suspected that pulse for seed is affected, it might be kiln-dried, at a temperature not high enough to injure the germinating power.

Peas and beas, concerning which there are suspicions that they contain larvæ, though there may not at present be any holes in them, should be well winnowed or cleaned with special screens, so that the light insect-affected pulse may be taken out as much as possible.

Farmers and market gardeners should be especially careful to examine peas and beans and, indeed, seeds of all kinds before they sow them. Much direct disappointment and great losses are caused by sowing seeds injured by insect agency ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

BRU'CINA. $C_{23}H_{26}N_2O_4 . 4Aq.$ [Eng., Fr.] *Syn.* BRU'CINE; BRU'CINA, L. An alkaloid discovered by Pelletier and Caventon in the bark of *Bru'cia antidysenter'ica*, and afterwards associated with strychnia in nux vomica.

Prep. Ground nux vomica, or the bark of *Brucia antidysenterica*, is boiled in dilute sulphuric acid, and the resulting decoction mixed with hydrate of lime (in excess); the crude precipitate thus obtained is boiled in alcohol (sp. gr. ·850), and the tincture filtered whilst hot. A mixture of crude strychnia and brucia is deposited as the fluid cools, and the remainder is obtained by evaporation. This is powdered and digested in cold alcohol, which dissolves out the brucia; the solution furnishes crystals on spontaneous evaporation. It may be further purified by recrystallisation from alcohol, or by the process of Dunstan and Short's 'Year-book of Pharmacy,' 1883, which yields a very pure brucine.

Prop. Soluble in 850 parts of cold, and about 500 parts of hot water; freely soluble in alcohol. Added to the dilute acids until they are neutralised, it forms crystallisable salts, easily obtainable by evaporation.

Tests. It is distinguished from strychnine, which in many respects it resembles, by its ready solubility in both dilute and absolute alcohol, and

its insolubility in ether. With nitric acid it strikes a fine red colour, which is removed by sulphuretted hydrogen and sulphurous acid. Iodic acid, chloric acid, and chlorine also turn it red.

Professor Sonnenschein has succeeded in converting brucine into strychnine. He says: "Brucine ($C_{23}H_{26}N_2O_4$) and strychnine ($C_{21}H_{22}N_2O_2$) differ apparently considerably in their composition; but the former may easily be converted into the latter." Referring to the formulæ, it will be seen that strychnine is produced by combining brucine with 4O, and eliminating $2H_2O$ and $2CO_2$. This is effected as follows: Brucine is moderately heated with 4 to 5 times its weight of diluted nitric acid, when a red coloration will be produced and gases evolved, which cause in a mixture of barium chloride and ammonia a white precipitate of carbonate of barium.

The red solution is concentrated in a water-bath, supersaturated with potassa, and agitated with ether, which, on spontaneous evaporation, leaves a reddish mass, containing a red colouring matter, a yellowish resin, and an alkaloid which is obtained pure by dissolving in an acid and crystallising. This base has the intensely bitter taste, and other properties of strychnine, gives the characteristic reactions with potassium chromate, cerium oxide, and sulphuric acid, and yields with chlorine the sparingly soluble compound. The muriate crystallises in fine silky needles, from which 9·20% of chlorine was obtained.

The conversion of brucine into strychnine is not only highly interesting, but it is likewise of great importance in forensic analysis, proving again that in such cases the employment of oxidising agents is admissible only with great caution. A student who had received for analysis a mixture containing, among other substances, brucine and nitrate of lead, employed the process of Stas and Otto for the separation of the alkaloids, and found strychnine instead of brucine, which had been oxidised by the liberated nitric acid.

"If strychnine is heated with a strong base like potassa, soda, or baryta, for some time, in a sealed glass tube placed in a water-bath, a body is obtained which no longer shows the reactions of strychnine, but resembles brucine in its reactions. The experiments on this decomposition, which is likewise of importance in forensic analysis, are not yet concluded."

Uses. Has been employed as a remedy for epilepsy in the same doses as strychnine. It is said to be only 1-24th the power of strychnine.

BRUISE (brōōze). *Syn.* CONTU'SIO, CONTU'SUM, L.; CONTUSION, MEURTRISSURE, Fr.; BRAUSCHE, QUETSCHUNG, &c., Ger. A contusion; but in popular language applied chiefly to cases in which there is an extravasation of blood owing to the rupture of the minute vessels, with consequent discoloration or tumefaction of the part.

Treatm. In common cases, sufficiently serious, bruises may be rubbed with a little tincture of arnica or soap liniment; or, if the inflammation be considerable, they may be bathed with a little weak goulard water, or with vinegar water. In more severe cases leeches may be applied. See CONTUSION.

Treatment for Animals. The same as for man.

BRUNS'WICK BLACK. See VARNISHES.

BRUNS'WICK GREEN. See GREEN PIGMENTS.

BRUSHES. Hair-brushes may be best washed in a moderately cold weak solution of borax. They should afterwards be rinsed in cold water and dried.

Oil-paint brushes of the sizes used by artists or sign painters, should never be allowed to dry, but as soon as the work is done the excess of paint should be squeezed out on the palette, and the brush further cleansed with turpentine or oil, or both, care being taken not to force the paint into the root of the brush, as this tends to spread the hairs and prevent the formation of a proper point or edge for working. Many artists clean their oil-colour brushes with soap, taking it up with the brush and rubbing it into a lather in the palm of the hand. This is a good plan, but is said by some to destroy the elasticity of the brush.

BRUSTBONBONS — PECTORAL BONBONS. [Fr.] (*Stollwerck,* Cologne.) Carageen, 3 parts; Iceland moss, 2 parts; red poppy petals, 1½ parts; coltsfoot, 1 part; liquorice, 2 parts; marsh-mallow root, 2 parts; daisy (*Bellis perennis*), 1½ parts; Souchong tea, 1 part; boiled with 24 parts of water till reduced to half, and the fluid afterwards mixed with refined sugar.

BRUSTGELEE—PECTORAL JELLY (*Daubitz,* Berlin). A yellowish-brown nearly clear jelly, with a sweet, weak anise, followed by a somewhat bitter taste, made of gelatin, 12 grms.; sugar, 60 grms; and a herbal infusion, 120 grms.; the latter made from anise, star-anise, Iceland moss, &c.

BRY'ONIN (-nĭn). A peculiar bitter principle extracted from the root of white bryony (*Bryonia dioica,* Jacq.). It is obtained from the dry extract of the expressed juice, by solution in alcohol, filtration, and cautious evaporation.

Prop., &c. A yellowish-white mass. It is a drastic purgative; and, in large doses, poisonous. It enters into the composition of several quack medicines.

BUAZE FIBRE. Made from the fibre *Securidaca longipedunculata,* Fres., a branching shrub of Zambesiland, Eastern Tropical Africa.

BUBBLE-AND-SQUEAK. In *cookery,* a species of olla podrida variously prepared, as the materials and fancy of the maker dictate.

Prep. (*Rundell.*) Take slices of cold meat, fry them quickly until brown, and put them into a dish to keep them hot. Then clean the pan from the fat; put in it greens and carrots (previously boiled and chopped small); add a little butter, pepper, and salt; make them very hot, and put them round the beef with a little gravy. Cold boiled pork is a better material for bubble-and-squeak than beef. In either case the slices should be very thin and lightly fried.

BUB'BLE FEVER‡. See PEMPHIGUS.

BU'CHU (-kū). Buchu leaves, from three species of *Barosma* (*B. crenulata,* Hook., *B. serratifolia,* Willd., and *B. betulina,* Bart., &c.), all natives of the Cape of Good Hope, and furnishing a stimulating tonic. See under DIOSMA.

BUCK'BEAN or **BOG'BEAN.** The *Menyanthes trifoliata.* See INFUSIONS.

BUCKINGHAM'S DYE for the whiskers; manufactured by R. E. Hall & Co., Nashua, N.H. This whisker dye is an ammoniacal solution of nitrate of silver, and consists of ½ gr. nitrate of silver, 2½ gr. solution of ammonia, and 40 gr. distilled water (*Dr Schacht*).

BUCK'THORN. *Syn.* RHAM'NUS, L. The *Rham'nus cathar'ticus,* Linn. Berries (BAC'CÆ RHAM'NI, L.; RHAMNI SUCCUS). A cathartic juice expressed from the berries. Given to animals as a purgative.

BUCK'WHEAT. Nat. Ord. POLYGONACEÆ. Mostly herbaceous plants, marked by the membranous sheath at the base of the stalk of their alternate leaves. Widely diffused; many are common and troublesome weeds, as the dock and knot-grass.

Buckwheat (*Polygonum fagopyrum,* Linn.). Long cultivated on the continent of Europe, and generally in temperate countries, for its farinaceous seeds, from which an excellent bread is made; it forms a staple food of the inhabitants of the Himalaya and Central Asia. Often planted in Britain for feeding game and poultry. Its native country is probably Russian or Western Asia.

BUG. *Syn.* CI'MEX, L.; PUNAISÉ, Fr.; WANSE, Ger. A name popularly and very loosely applied to a vast number of insects that infest houses and plants; in *zoology,* hemipterous insects of the genus 'Cimex,' of which there are many hundred species: appr., the bed-bug.

Bug. *Syn.* BED'-BUG, HOUSE'-B., WALL'-B., WALL'-LOUSE*, &c.; CI'MEX DOMES'TICUS, C. LECTULA''RIUS, Linn., L.; PUNAISÉ, Fr.; BETTWANZE, HÄUSWANSE, Ger. An insect too well known in all the larger towns of Europe and America, and in the huts of squalid poverty everywhere, to require a description here. It is almost the only species of the bug kind that has undeveloped wings. Its introduction to England is believed to have occurred soon after the great Fire of London (A.D. 1666). Human blood appears to be its favourite food; but it will also eat grain, seed, flour, dried paste, size, soft deal, beech, osier, &c. Cedar, mahogany, and the odorous and harder woods are usually avoided by this insect. Aromatics, perfumes, and strong odours generally are unfavourable to its propagation.

Exterm., &c. Various means have been adopted to prevent the accession, and to destroy or drive away these enemies of "tired nature's sweet restorer, balmy sleep." Among the most certain of these is thorough cleanliness and ventilation. The furniture-brokers put articles infested with these insects into a room with doors and windows fitting quite close, and subject them to the fumes of burning sulphur or chlorine gas. In the small way poisonous washes are commonly resorted to. For this purpose nothing is more effective than chloride of lime or chloride of zinc; the latter being preferable to the other on account of its being comparatively scentless.

The following mixtures are in common use, or have been recommended for this purpose:

1. Corrosive sublimate (in powder) and hydrochloric acid, of each, 1 oz.; hot water, ¾ pint; agitate them together until the first is completely dissolved. It is applied with a paint-brush, observing to rub it well into the cracks and joints. This is the common 'bug-wash' of the shops. It is a deadly poison!

2. As the last, but substituting 2 oz. of sal-ammoniac for the hydrochloric acid.

3. Oil of turpentine, 1 pint; camphor, 2 oz.; dissolve. Very cleanly and effective.

4. Tobacco-water, made by steeping 2 oz. of good shag in 1 pint of warm water for a few hours.

5. Crude pyroligneous acid.

6. Coal-tar naphtha. This, as well as No. 3 (*above*), should never be used by candle-light, as it is excessively inflammable. When the smell of the common naphtha is objectionable, benzol or benzine may be used instead. The celebrated nostrum vended under the name of 'Insecticide' is said to be nothing but benzol.

7. Sulphurated potash (in powder), 6 oz.; soft soap, ½ lb.; oil of turpentine, ¼ pint or q. s. to make a species of soft ointment. The odour of the last three (Nos. 5, 6, 7) is rather persistent and disagreeable; but they are very effective.

8. Strong mercurial ointment, soft soap, and oil of turpentine, equal parts, triturated together. Rather greasy and dirty.

9. Scotch or Welsh snuff, mixed with twice its weight of soft soap.

10. Sulphur, or squills, in impalpable powder, blown into the cracks or joints, or scattered in a fine cloud, by means of a hollow ball or balloon of vulcanised india-rubber filled with it and furnished with a small wooden jet or mouth-piece, or in any other convenient manner. Very cleanly and effective. Dumont's 'Patent Vermin Killer,' as well as the whole host of imitations of it, is of this kind.

Obs. Out of the above list there is ample room for selection. The common practice is to take the bedstead or other piece of furniture to pieces before applying them.

These pests exist only in dirty houses. A careful housewife or servant will soon completely destroy them. The surest method of destruction is to catch them individually when they attack the person in bed. When their bite is felt, instantly rise and light a candle and capture them. This may be troublesome, but if there be not a great number a few nights will finish them. When there is a large number, and they have gained a lodgment in the timbers, take the bed in pieces, and fill in all the apertures and joints with a mixture of soft soap and Scotch snuff. A piece of wicker-work, called a BUG-TRAP, placed at the head of the bed, forms a receptacle for them, and then they may be daily caught till no more are left. Oil-painting a wall is a sure means of excluding and destroying them. It has been asserted that these insects are so fond of narrow-leaved dittany or pepperwort (*Lepidium ruderale*), that if a bunch of it be suspended near their haunts they will settle in it, and may be thus easily captured. It is said to be commonly used as a bug-trap in some of our rural districts. Water, poured boiling from the spout of a kettle into the cracks and joints, is a cleanly and certain remedy, which we have often seen employed; so also is a jet of steam; they are both destructive to all insects, and will be found particularly so to beetles.

The proper time for attacking these pests is early in March, or shortly before they are revived from their dormant state by the warm weather. See INSECTS.

Bug, Harvest. See ACARI.

BU'GLE (bu'gl). An elongated cylindrical glass bead. See BEAD.

BUILDING STONES. Amongst the calcareous and magnesian stones used for building, many of the fine-grained and porous varieties are liable to split into flakes after a few years' exposure to the atmosphere, owing to the absorption by the stone of water, which, becoming frozen during severe weather, fractures the stone by its expansion. Brard invented a simple means of ascertaining whether a building stone is liable to this defect, which consists in taking a smoothly-cut block of the stone, 1 or 2 inches square, and placing it in a cold saturated solution of sodic sulphate. The temperature of the solution is gradually raised to the boiling point; it is allowed to boil for half an hour, and then the stone is left to cool in the liquid. When cold it is suspended over a dish, and once a day for a week or a fortnight plunged for a few moments into a cold saturated solution of sodic sulphate, and it is then again freely suspended in the air. The sulphate crystallises in the pores of the stone and splits off fragments of it. A similar experiment is made upon an equal-sized mass of stone which is known to be free from this defect. By the comparative weight of these fragments in the two cases the tendency of the stone to the defect in question may be estimated.

A stone that is placed in a building in a position similar to that in which it is found in the quarry, that is, with its seams lying horizontally, is found to resist the weather much more successfully than one that has not been so placed.

BUMPING or SUCCUSSION. This is an inconvenient phenomenon which often happens during boiling and distillation, due to the sudden formation of steam at certain points in the vessel. For its prevention it is recommended to place in the still or other vessel pieces of platinum wire, pumice-stone, or asbestos. Reissman recommends winding platinum wire round pumice-stone, of which plan he speaks highly. Broken pieces of the stems of clay pipes answer very well when the nature of the fluid permits of their use. The action of all these devices is simply the provision of a large number of points from which the steam is given off quietly.

BUN. A well-known kind of light, sweet cake.

Prep. 1. BATH BUNS. As 6, but adding a little candied lemon and orange peel, and putting a little grated peel and a few caraway comfits on the top of each.

2. CROSS BUNS. Flour, 2½ *lbs.*; sifted sugar, ½ *lb.*; coriander seeds, cassia, and mace, of each (powdered), a sufficiency; make a paste with butter, ½ *lb.*; (dissolved in) hot milk, ½ pint; work with 3 tablespoonfuls of yeast; set it before the fire for an hour to rise, then make it into buns, and set them before the fire on a tin for half an hour; lastly, brush them over with warm milk, and bake them to a nice brown in a moderate oven.

3. MADEIRA BUNS. Butter, 8 *oz.*; 2 eggs; flour, 1 *lb.*; powdered sugar, 6 *oz.*; half a nutmeg (grated); powdered ginger and caraway seeds, of each, ½ teaspoonful; work well together, then add as much milk as required, and ferment; lastly, bake on tins in a quick oven.

4. PLAIN BUNS. Flour, 2 *lbs.*; butter ¼ *lb.*; sugar, 6 *oz.*; a little salt, caraway, and ginger; make a paste with yeast, 4 spoonfuls, and warm milk, q. s.; as before.

5. PENNY BUNS. To the last add of currants, well washed, ½ *lb.*; and water, stained by steeping a little saffron in, q. s. to give a light yellow tinge to them.

6. RICH BUNS. Fine flour, 3 *lbs.*; sugar, 1 *lb.*; butter, 2 *lbs.* (melted and beat with) rose water, 4 *oz.*; currants, 1 *lb.*; yeast, ¼ pint; as before.

Obs. The great secret in producing good buns is the use of sweet yeast and the best currants only, and thoroughly washing these last in a sieve or colander, to remove grit, before adding them to the dough.

BUNION (-yŭn). A species of corn or swelling on the ball of the great toe, resulting from pressure, and irritation by friction. The treatment recommended for corns applies also to bunions; but in consequence of the greater extension of the disease, the cure is more tedious. A bunion may often be effectually stopped and removed by poulticing it, and, at the proper time, carefully opening it with a lancet. See CORNS.

BURETTE. An apparatus consisting mainly of a graduated glass tube, which is employed in volumetric analysis for the delivery of an accurately measured quantity of any particular standard solution. Burettes are made in various different forms; a detailed description of them is to be found in Fresenius' 'Quantitative Analysis,' and Sutton's 'Volumetric Analysis.' For general purposes the burette designed by Mohr, or Buchanan's modification of it (with either an india-rubber tube and clip, or a glass stopcock, and having a capacity of 50 c.c.), is the best of all.

The first burette was invented by Gay-Lussac (see fig. 1).

It rarely, if ever, has a capacity greater than 50 c.c., and consists of a narrow tube fused on to a wider one. The larger tube is about 33 cm. long (the graduated portion occupying about 25 cm.), and 15 mm. in internal diameter; the narrow tube has a diameter of 4 mm., which in the upper bent end decreases to 2 mm. When used, the instrument should be held in the left hand, the bottom part being allowed to lean a little against the chest. The operation is aided by giving the instrument from time to time a slight turn in the direction of its longitudinal axis, thereby placing the curve of the spout alternately in a more vertical, alternately in a more horizontal position. The volume must not be read off before the surface of the liquid has attained a constant height.

This burette is always supplied with a suitable wooden foot, so that it can stand upright. It is useful for working with solutions like that of permanganate of potash, which act upon indiarubber, when a Mohr's burette with glass stopcock is not available. But it has certain disadvantages, the chief of which are that it is not so easy to mani-

pulate as Mohr's, and that the heat of the hand may perceptibly alter the volume of the enclosed liquid. By inserting a well-fitting cork, through

Fig. 1.

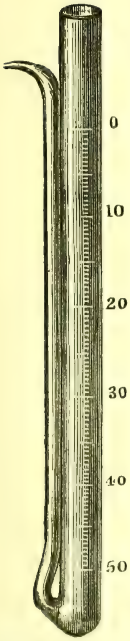
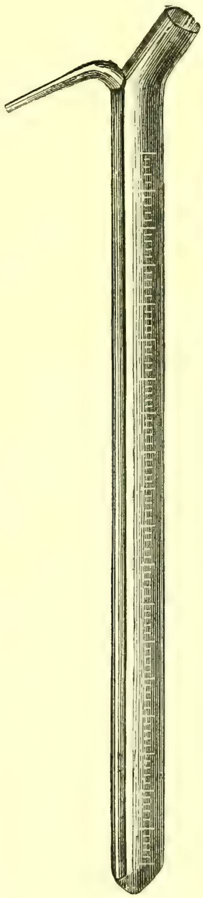


Fig. 1 *a*.



which a glass tube passes into the top of it, these drawbacks may be to some extent overcome; the burette can now be allowed to stand upright, and the liquid ejected from it by blowing through this attached mouthpiece. Or, instead of (and better than) blowing, Mohr's device of attaching to this tube an india-rubber ball with two openings —one of these serving to join it to the tube—may be employed. On closing the second opening of the ball by the thumb and pressing, the solution is driven out of the burette; while, on removing the thumb, the ball refills itself with air.

The Geissler burette (fig. 1 *a*) is a modification of Gay-Lussac's; in it the fine tube is enclosed within the large one. It is a difficult instrument to make, but is very convenient, and less easily broken than Gay-Lussac's original form.

Mohr's burette is familiar to every one who has had any experience in laboratory work. The two subjoined figures (2 and 3) almost explain it sufficiently without further words. It is usually made to hold 50 c.c. of liquid and graduated into tenths of a c.c., although in special cases it may be either larger or smaller. The length of such a (50 c.c.) burette, not including the outlet tube, is about 60 cm., and its internal diameter about 6 to 7 mm. It is closed either by a small piece of

Fig. 2.

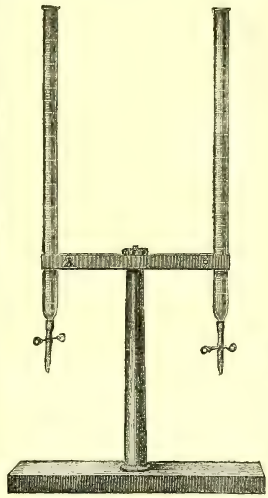
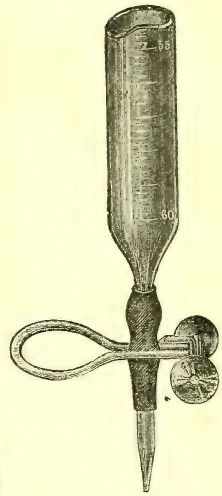


Fig. 3.



india-rubber tubing with pinchcock (clip), or is made with a glass stopcock (the engravings show the former). By pressing the clip the rubber tube is slightly opened, and the contained liquid allowed to drop out. With a little practice the process becomes quite easy. The rubber must be renewed whenever it tends to become at all sticky, and ceases to open at once on pressing the clip. Various forms of pinchcock may be used, but that shown in the above figures, which is made of brass and soldered, is the most common. Burettes with glass stopcocks are often not quite tight, so they require to be tested for this. In cases where there is no objection to it (on the score of action by the liquid), the stopcock can frequently be made tight by a mere film of lard; but this is of course inadmissible when dealing with liquids like permanganate of potash. The burette is filled through a small funnel held at the top of it. Before beginning a titration, the burette must be carefully washed with water, and then with the solution to be used, in order to displace the last drops of water. All air-bubbles (which sometimes collect inside the india-rubber tube and are a little hard to dislodge) must be got rid of by allowing some of the solution to be ejected rather violently; this is managed by filling the burette and then opening and closing the clip somewhat sharply several times, until the air has been expelled.

"There is an arrangement of Mohr's burette which is extremely serviceable when a series of analyses of the same character have to be made, such as in alkali works, assay offices, &c. It consists in having a T-piece of glass tube inserted between the lower end of the burette and the spring clip, which communicates with a reservoir of the standard solution placed above, so that the burette may be filled as often as emptied by a

siphon, and in so gradual a manner that no air-bubbles occur, as in the case of filling it with a funnel or pouring in liquid from a bottle; besides which, this plan prevents evaporation or dust in the standard solution either in the burette or

Fig. 4.

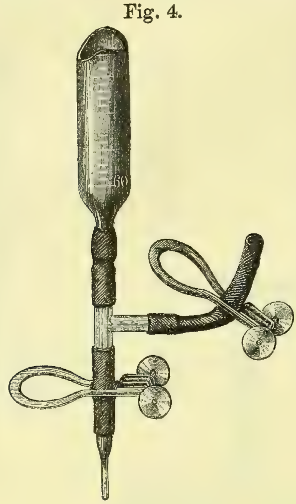
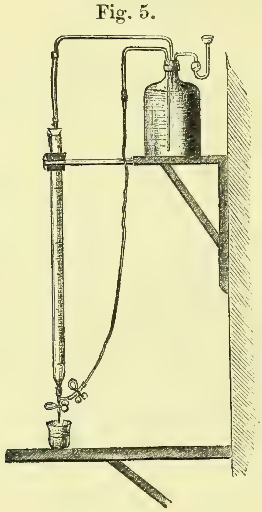


Fig. 5.



reservoir. Figs. 4 and 5 show this arrangement in detail" (*Sutton*, 4th edition, pp. 11 and 12).

An arrangement of this kind is obviously of great advantage when one is working with solutions which are affected by the carbonic acid of the air, *e.g.* a solution of hydrate of baryta.

Perhaps the most convenient of all burettes is that modification of Mohr's devised by Mr J. Y. Buchanan, of the *Challenger* expedition. This is simply a Mohr's burette drawn out at its upper end (*a*) in the form of a pipette (fig. 6). It is filled by suction from below by attaching a piece of narrow glass tubing (*b*) with rubber end-piece (fig. 7) to the lower end (*c*) of the burette, and a mouthpiece (*d*), also made of simple glass and rubber tubing (fig. 8) to the upper end (*a*). On

Fig. 6.

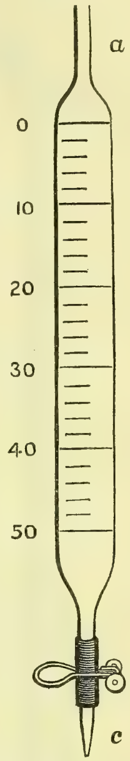


Fig. 7.

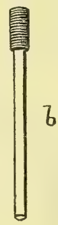
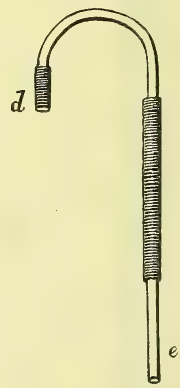


Fig. 8.

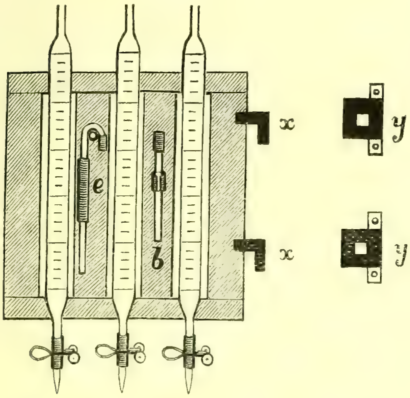


now dipping (*b*) into the bottle which contains the solution in use, and applying suction at (*e*), the burette is readily filled from below. Besides being available for liquids, such as hydrate of baryta solution, which are affected by the carbonic action of the air, this form of burette has the further great advantage of being easily closed when not in use by a tiny piece of glass rod inserted in a little bit of rubber tubing. As space was valuable on board the *Challenger* (not to speak of the motion of the vessel), Mr Buchanan further devised a wooden frame to hold three such burettes (fig. 9), which was attachable by well-fitting solid brass rectangular hooks (*xx*) to small brass squares (*yy*) affixed to any convenient wooden partition. It will be obvious, from the subjoined figure, that the frame could be brought out at right angles to the wall when the burettes were wanted for use, or placed flush with it when they were done with. This arrangement is also very convenient in a laboratory. Tubes (*b*) and (*e*) were likewise conveniently attached to the wooden frame; (*e*) hung on a hook, and (*b*) held fast by a small piece of split rubber tubing nailed into the wood.

Reading of Burettes. Before concluding this article, a few words must be said upon the reading of burettes—a point of much importance. To

begin with, the burette must of course be kept away from gas-jets or other sources of heat,

Fig. 9.



which would cause the enclosed liquid to expand; for the same reason, when it is necessary to hold a burette in the hand, only the top part, which is above the level of the liquid, should be touched. The reading of a burette is quite simple if one attends to the following points: (1) The liquid to be read off must be on a level with the eye; this is very conveniently attained by nailing a small bar of wood across a window at a proper level, and holding the burette against it so that the level of the contained liquid is always a little above it—say an inch; this is, on the whole, the best and simplest way of reading a burette. (2) A fixed and unalterable standard of what is to be considered the surface of the liquid (for reading purposes) must be adhered to. It would never do to read at one time from the top, at another from the middle, and at a third from the bottom of the meniscus.

If you hold a burette partly filled with water between the eye and a strongly illumined wall, the surface of the fluid presents the appearance shown in fig. 10; while if you hold close behind

Fig. 10.

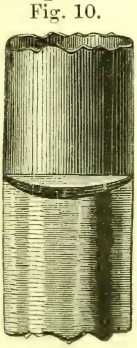
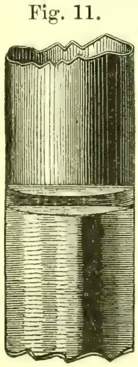


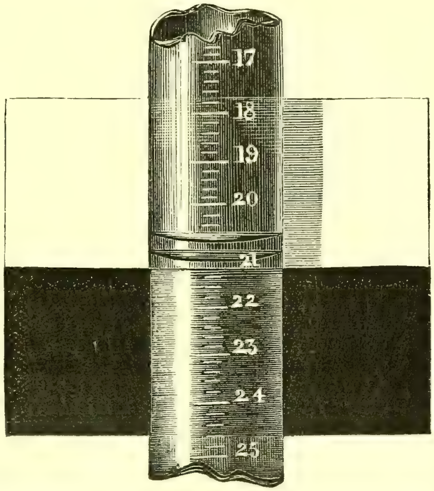
Fig. 11.



the burette a sheet of white paper with a strong light falling on it, the surface of the fluid will present an appearance similar to that shown in fig. 11.

In both cases you have read off at the lower border of the dark zone, this being the most distinctly marked line. Its distinctness may be heightened by adopting Mohr's contrivance, which consists in pasting on a sheet of very white cardboard a broad strip of black paper, and, when reading off, holding this close behind the burette in such a position as to place the border line between white and black from 2 to 3 mm. below the lower border of the dark zone, as shown in fig. 12.

Fig. 12.



Great care must be taken to hold the paper invariably in the same position, since, if it be depressed, the lower border of the black zone will move higher up.

To test the correctness of the graduation of a burette, proceed as follows: Fill the instrument up to the highest division with water at 16° C. (60·8° F.), and then let 10 c.c. of the liquid flow out into an accurately weighed flask, and determine the weight of these 10 c.c. in the usual way; then allow another quantity of 10 c.c. to flow out, and weigh again, and repeat the operation until the contents of the burette are exhausted. If the instrument be correctly graduated, every 10 c.c. of water at 16° C. will weigh 9·990 grms. This operation is, of course, still more exact if we use mercury instead of water, and weigh the mercury from each 5 c.c. of the burette.

BURG'LARIES. The common precautions of locks and bolts, alarum-bells and firearms, are frequently found useless in preserving houses from burglars; but a light in the upper part of the house, or a small dog on the ground-floor, with the means of running into a place of safety from its enemies, has been seldom known to fail. A combination of the two would undoubtedly be doubly effective. The bark of the dog and the fear of detection by the approach of the light would deter the majority of rogues of common pluck and feeling. A dog out of doors, and consequently accessible, however large and fierce, is easily pacified or silenced by men of the class referred to.

BURI NUT or **MAKETA** of the Fijis (*Prunus laurinum*, Gray). The kernels are beaten up, made

into a kind of putty, and used for stopping holes in canoes, and for fixing spear-heads (see specimen from the Admiralty Islands) to the shafts.

BURLS, REMOVAL OF, from Cloth and Wool. Introduce the wool or the woollen goods into 104 litres of sulphuric acid at 6° B., in which 500 grms. of alum and 250 grms. of salt have been dissolved. Work in this bath for one or two hours, drain in the centrifugal, and hang up at 100° to 120° F. Wash for an hour and a half in clear water, treat for two hours with fuller's-earth, soda and lime, and wash again for two hours. Sulphuric acid is adapted only for whites and indigo blues. For coloured goods, solutions of chloride of tin and chloride of manganese at 6° B., are recommended.

BURNING-GLASS. See LENS.

BURNS AND SCALDS. A slight degree of heat will cause redness of the skin and some tenderness, followed some days afterwards by desquamation, but leaving no trace of the injury behind; if the heat be greater there is more or less severe pain, great redness of the injured and surrounding part, and blistering of the spot itself. The blister disappears after a longer or shorter time, and no permanent injury is caused. When the heat is sufficiently great to cause destruction of the skin to a greater or lesser depth, there is usually very great pain, followed by destructive inflammation and sloughing of the injured part, with the production of a permanent scar. The process of sloughing after burns is generally much longer than after other injuries, and is accompanied by far greater pain and constitutional disturbance, especially if large areas of skin are affected. When more than half the skin of the body is destroyed by a burn or scald the patient very rarely recovers.

About 48 hours after a burn or scald the reaction usually begins, and the part discharges pus, generally of a very offensive odour. There is fever, loss of appetite, and very commonly constipation followed by diarrhœa, with liability to inflammation of the internal organs, *e. g.* the lungs and intestines. In severe burns the shock to the system is often very great, and is almost always greater than in a case of equal injury from other causes.

Treatm. Local in cases of burns without blistering. Bathe the part in hot or cold water, and apply flour, starch, or collodion. Wrap the part in cotton wool. When there is a blister, it should be pricked and the contents let out, and the wound dressed with a piece of lint soaked in oil or smeared with vaseline, kept in its place with a pad of cotton wool and a bandage. Chalk and vinegar made into a cream, and smeared over the blistered part, is said to be a good application.

The treatment of very severe burns requires considerable skill and care, especially if there is any risk of scarring or disfigurement.

In cases of severe burns or scalds the clothing should never be pulled off the patient, but cut away piece by piece, and no attempt should be made to remove pieces which may be adherent to the injured parts. This done, the part should be covered as quickly as possible with a mixture of equal parts of linseed oil or olive oil and lime water (carron oil) spread on pieces of lint, with a trace of carbolic acid. The lint should be in several pieces, so as to facilitate future dressing; cotton wool may be laid over the part, and the whole should be left undisturbed as long as possible in fact—until the offensive nature of the discharge or the discomfort of the patient necessitates a fresh dressing. In some cases the application of the first dressing is so painful that it is necessary to administer chloroform.

Constitutional Treatm. In the early stages of severe burns it is often necessary to give stimulants, such as alcohol and ammonia. The patient should also be kept warm, and should have such light food as he may be capable of taking; opiates and other anodynes may be necessary in order to relieve the pain, which is often very intense. When the suppuration is fairly begun the patient should have plenty of good, nourishing food. The treatment of scalds is essentially the same as that indicated for burns, and the same precautions must be observed. It should be remembered that one of the first objects of the treatment is to exclude the air, and that there should in consequence be no tampering or interference with the first dressing until it is necessary to change it. The prevention of scars and the minimising of the disfigurement caused by burns requires all the surgeon's skill, even when the case has been carefully and properly treated from the first; and his task will be rendered doubly difficult if the early treatment have been improper, or if the dressing have been interfered with.

BUTEA FRONDOSA, Roxb. (Ind. Ph.) *Syn.* BENGAL KINO TREE. *Habitat.* Common all over India.—*Officinal part.* The inspissated juice obtained from the stem by incision (*Buteæ gummi, Kino bengalensis, Bengal kino*). It occurs in the form of irregular shining fragments, seldom as large as a pea; more or less mixed with adherent pieces of greyish bark; of an intense ruby colour and astringent taste; soluble, but not freely so, in water and in alcohol. Its astringency is due to the presence of tannic and gallic acids.—*Prop. & Uses.* Similar to those of kino, for which it has been found an efficient substitute. —*Prep.* Same as those of kino.

BUTTER. [Eng., Ger.] *Syn.* BUTY'RUM, L.; BEURRE, Fr.; BUTER, BUTERA, Sax. The fatty matter obtained from cream by churning it.

Manuf. The process of making butter by the common operation of churning is extremely simple, and is well known. The chief objects to attend to are maintaining a proper temperature, and a certain degree of exposure to the air. Extreme cleanliness must also be observed, the churn and other utensils being frequently scalded out with water. When the butter is 'come,' it should be put into a fresh-scalded pan, or tub, which has been standing in cold water, cold water poured on it, and after it has acquired some hardness, it should be well beaten with a flat board until not the least taste of the buttermilk remains, and the water, which must be often changed, becomes quite colourless and tasteless. A little salt may then be worked into it; after which it may be weighed and made into 'forms,' which should then be thrown into cold water contained in an earthen pan provided with a cover. In this way nice and cool butter may be obtained in the hottest weather.

At Dumbarton the newly separated butter is put into a clean vessel, and a corn sickle is drawn several times crosswise through it, to extract any hairs that may adhere to it. This operation is performed in very cold spring water, and is followed by thoroughly washing it therein. 10 oz. of salt are now added to every stone weight of the butter, and well mixed in.

In Devonshire the milk is generally scalded in copper pans over a charcoal or wood fire, and the cream collected as soon as it rises, or, and more frequently, when the whole has got cold. It is then churned in the usual way. On the small scale the butter is commonly obtained from this cream by patiently working it with the hand in a shallow pan or tub. Without care the cream is apt to absorb some of the fumes from the charcoal, which impart a peculiar taste to the butter. This is the reason why some of the Devonshire butter has a slight smoky flavour. It may be removed by thorough washing in cold water. Of late years, in the large dairy-farms of Devonshire, covered flues, with openings to receive the bottoms of the pans, have superseded open fires, by which the danger of contamination from the fumes is removed.

Choice. Fresh butter has a pleasant odour, and is of an equal colour throughout its substance. If it smells sour, the buttermilk has not been well washed out; and if it is streaked or veiny, it is probably mixed with stale butter or lard. A good way to try butter is to thrust a knife into it, which should not smell rancid and unpleasant when withdrawn. Rancid and stale butter, when eaten in quantity, is capable of producing dangerous symptoms.

Pur. The cheaper kinds of butter are frequently adulterated with common wheat-flour, oatmeal, pea-flour, lard, and is sometimes mixed with suet and turnips, as well as with a large quantity of salt and water. The trick is concocted between the Irish factors and the London dealers. The higher priced article is seldom mixed with anything beyond an excess of salt and water, notwithstanding the assertions of alarmists to the contrary. The presence of lard may be detected by the flavour and paleness of the colour. A little of the sample adulterated with the other substances named, if melted in a glass tube or phial, will separate into strata, which are very marked when cold.

Quantitative Analysis of Butter. 1. The following process for the analysis of butter, by Mr A. H. Allen, is extracted from the 'Chemical News' (xxxii, 77): The Society of Public Analysts has adopted 80% as the lowest limit of fat contained in a genuine butter.

The amount of water is best ascertained by heating 5 grms. of the butter in a small weighed beaker to a temperature of about 110° or 120° C. for an hour or so. Some chemists merely heat the butter on a water-bath. According to the author's experience, perfect drying is next to impossible at that temperature.

The dried butter is next treated in the beaker with anhydrous ether, or commercial benzoline. The former liquid is expensive and inconveniently volatile, while it must be used in a perfectly anhydrous condition (to avoid solution of the salt), and except when boiling has but a limited solvent power for butter, especially when adulterated. Benzoline dissolves fat more readily than ether; it does not volatilise so rapidly at ordinary temperatures, it is always anhydrous, and has the advantage of low price. The 'benzoline' employed by the author is made by re-distilling the commercial article from a retort immersed in a bath of boiling water. About 1-3rd of the original bulk usually comes over readily at 100° C., and has a gravity of 0·689.

On warming the beaker containing the benzoline the dry butter readily dissolves. The liquid is poured on a small dry filter and washed with warm benzoline, the filtrate being collected in a small wide beaker. If the filter had been previously weighed, its increase of weight, after careful drying, will of course give the quantity of curd and salt in the 5 grms. of butter taken. Except in cases in which extreme accuracy is desired, it is preferable to scrape the residue off the filter and weigh it separately.

The error (owing to imperfect removal) only amounts to $\frac{1}{10}$% to $\frac{2}{10}$% of the butter taken. As the salt is accurately estimated afterwards, the loss falls on the curd. The salt may be determined by careful ignition of the filter and residue, the incombustible matter consisting almost wholly of common salt, while the curd is ascertained by loss of weight. This method is not to be recommended; for without great care some of the salt will be volatilised and lost, the error causing the amount of curd to appear excessive.

Ignition also renders any further examination of the curd an impossibility. A far preferable plan is to return the weighed curd and salt to the filter, and to wash them with cold water. The filtrate is made up to 100 c.c., and the salt is estimated in a half of it by titrating with decinormal nitrate of silver. The remaining portion of the solution can be employed for the estimation of sugar if desired. This is effected by inverse titration with Fehling's copper solution, in the same way as grape-sugar. The estimation of sugar may sometimes be of interest, as a means of ascertaining whether the aqueous portion of the butter consisted of mere water or of serum of milk. In other words, the estimation of sugar may furnish a means of ascertaining whether an excess of water in the butter is due to insufficient removal of the buttermilk, or to subsequent incorporation of water. Every 0·001 grm. of milk-sugar represents about 0·022 of average milk-serum.

The residue, insoluble in cold water, usually consists almost wholly of casein. If, however, the butter has been adulterated with mashed potatoes, flour, or other starchy matters—said to be occasionally employed—they will be found here. The presence of starch in the residue will of course be readily indicated by treating it with hot water, and testing the cooled liquid with solution of iodine. By pressing out a small portion of the butter between two slips of glass, so as to obtain a thin film, and observing it under the microscope (or by observing the caseous residue after treatment with cold water), the nature of the starch may be ascertained.

The solution of the fatty matter in benzoline is

evaporated at 100° C. till it no longer decreases in weight. The average proportion of fatty matter in butter is about 85%. If less than 80% the butter must be considered adulterated. It is evident that a careful estimation of the percentage of fatty matter would often render separate estimations of the water, curd, and salt unnecessary; for unless the sum of the three latter constituents exceeded 20% the butter could not be considered as adulterated, unless by an admixture of other fats.

An easy and rapid method of estimating the fat in the undried butter is therefore a great desideratum; but unfortunately no satisfactory method is at present known. The indirect estimation of the fat, by subtracting the sum of the percentages of water, curd, and salt from 100·00, ought to agree with the direct estimation of fat within 0·5%, and the variation is often much less.

2. Dr Dupré adopts the following method: About 5 grms. of dry filtered butter fat are weighed in a small strong flask; 25 c.c. of a normal alcoholic soda solution here are added; the flask is closed by means of a well-fitting caoutchouc stopper, firmly secured by a piece of canvas and string, and heated in a water-bath for about an hour. When cool the flask is opened, the contents—which are semi-solid—carefully liquefied by heat, and washed into a flask with hot water. This flask is now heated for some time on a water-bath to expel the alcohol, some more hot water is added, and 25 c.c. of diluted sulphuric acid, somewhat stronger than the alkali used, are run in. The contents are allowed to cool, and the acid aqueous solution below the cake of fatty acids is passed through a filter. The fatty acids in the flask are washed by hot water in the manner recommended by Dr Muter, *i. e.* each time allowed to cool; all the washings are passed through a filter.

The author uses no cambric, but passes everything through paper. With care scarcely any of the fatty acid will find its way into the filter. After the washing with water is completed and the flask drained, he washes any fatty acid that may be on the filter into the flask by means of a mixture of alcohol and ether on a water-bath, and finally dries the fatty acids in the flask at a temperature of 105° C. The drying can be done readily if the melted fat is now and then shaken briskly, so as to subdivide the water as much as possible. In this way the acids when once in the flask are not taken out until their weight has been taken, thus reducing the risk of loss to a minimum. Meanwhile the acidity of the aqueous filtrate and washings is estimated by decinormal soda solution. Subtracting from the amount required the proportion necessary to neutralise the excess of acid added in decomposing the soap, the rest represents the soluble fatty acids contained in the butter taken, and on the assumption of its being butyric acid, we can, of course, calculate the amount of this acid present. When once the equivalent of the soluble acids present in butter is fairly determined, this, of course, will have to be substituted for that of butyric acid. The results thus obtained are very accurate, and the process is very simple in execution.

The author has satisfied himself by repeated experiments that the alkalinity of the alcoholic soda solution by itself is not altered by the process. The author places no reliance on the specific gravity test, as he finds that mutton dripping and other fats are likely to be used as adulterants of butter, and may acquire a specific gravity above ·911 by being strongly and repeatedly heated. He thinks, however, that any sample of butter below ·911 may safely be pronounced adulterated.

In a subsequent note Dr Dupré states that he has effected the saponification, decomposition of the soap, and the washing and drying of the fatty acids at ordinary temperature, thus still further reducing the risk of breaking up the higher into lower acids. The saponification is readily effected by using a sufficiency of alcoholic soda. Between 4 and 5 grms. of the dry butter-fat were shaken up for several minutes with 100 c.c. of normal alcoholic soda. The butter soon dissolves, but after a time the solution gelatinises to a clear transparent mass. (The temperature of the laboratory at the time of these experiments ranged between 22° and 50°.) This jelly is now allowed to stand overnight, during which time the smell of butyric ether, very strong at first, entirely disappears. In one of the experiments the alcohol was allowed to evaporate spontaneously before the acid was added; in the other (made with a different sample of butter) the soap was dissolved in about half a litre of water, and at once decomposed by the addition of hydrochloric acid.

The fatty acids which separated in white curdy masses were thoroughly washed on a filter with cold water, about four litres, dried *in vacuo* over oil of vitriol, and weighed. The results of experiment show that butter fat yields the same proportion of insoluble fatty acids when saponified with or without the aid of heat.

3. (*Mr Gatehouse.*) *Rapid Method of detecting the Adulterations of Butter with other Fats.* The following comparative method is based upon the insolubility of potassium stearate in alkaline solutions when the stearate has been produced at high temperatures.

Before applying the test it is essential to remove all curd, buttermilk, and salt, by washing with hot water or dissolving in ether. 20 gr. of the butter are placed in a large test-tube 1-3rd full with water boiled thoroughly, and allowed to stand till the fat separates. The fat is either dissolved in ether, and after evaporation saponified, or the lower layer of the liquid is drawn off by a pipette as follows: A thin glass tube is drawn out to a fairly fine point and bent at the top to an obtuse angle. Whilst the butter is still liquid this nozzle is inserted into the bottom of the test-tube, placing the finger over the upper end to prevent any liquid from getting in till it reaches the bottom. When fairly cold the liquid may be withdrawn by a pipette attached to the tube. This process can be repeated till the washings are free from chlorides.

The saponification is effected by heating the purified butter with $\frac{1}{3}$—$\frac{1}{2}$ of its own weight of pure solid potassium hydrate (purified by alcohol) to a temperature about 420° F.; applying the

heat gently at first, and when the frothing ceases heating it more strongly, till no further apparent action occurs. The ultimate temperature during saponification must be kept above 400° F. for some minutes, otherwise the stearate formed will be soluble instead of insoluble in the alkaline solution.

If the butter is pure, the colour of the residue will be at the utmost light yellow; but should the butter be adulterated to any extent, it may be almost black. Too much reliance must not, however, be placed on the colour.

After allowing the tube and its contents to cool, the mass is boiled with successive portions of distilled water till 6 oz. (or 200 c.c.) altogether have been used. If the butter is pure, a portion of this solution poured into a test-tube will present only a faint opalescence; if, on the other hand, the butter is impure, a decided opacity will be perceived, the degree depending upon the amount of adulteration.

The amount of adulteration in any sample is determined by first obtaining pure butter and adding to separate portions of it known percentages of lard, &c. Each of these can be saponified as stated above; they are then corked up in tubes of equal diameter and labelled with the percentage of lard they contain. On comparing them it will be seen that 2% of lard can be clearly indicated.

When a butter is analysed all that is needed is to saponify, make up to the correct strength, and after cooling pour into a test-tube and compare with the specimen tubes.

4. (*Dr Redwood.*) *The Determination of the Melting-points of Butter and other Fats.* The apparatus in the form suited for general use consists of a basin, two small beakers, and a thermometer. The author uses an enamelled iron basin about 6 inches in diameter and $3\frac{1}{2}$ inches deep. In this is placed a beaker $4\frac{1}{2}$ inches deep and 3 inches in diameter, and within this beaker is placed another much smaller one, supported by its projecting rim on a disk of tinplate or copper, the outer edge of which rests on the mouth of the larger beaker. Some mercury is put in the smaller beaker to the depth of about an inch, and cold water into the larger beaker, so that its surface shall be half an inch or an inch higher than that of the mercury.

A small drop of the fat which has been previously melted and heated to several degrees above its melting-point, but has been allowed to cool again to near its setting-point, is put on the surface of the cold mercury. This is best done by means of a thin glass rod about 1-8th of an inch in diameter, the end of which has been rounded off in the blowpipe flame.

It is important that the drop should be very small, and its temperature when placed on the mercury not much above its melting-point, for if it be too hot it will spread over the surface of the mercury, which is not desirable.

If the rounded end of the rod be slightly dipped into the melted fat, and then brought to the surface of the mercury, a small hemispherical particle will attach itself there and speedily congeal, becoming more or less opaque in doing so. The weight of one of these hemispherical masses, which should not be more than 1-8th of an inch in diameter, will be from $\frac{1}{60}$ to $\frac{1}{10}$ of a grain. Having placed the drop of fat upon the mercury, the bulb of a thermometer, with sufficiently minute graduations, is introduced into the mercury and hot water poured into the basin. The heat is thus communicated to the contents of the small beaker slowly through the water in the larger beaker, and the rise of temperature in the mercury may be easily regulated, and should take place at the rate of about 1° per minute.

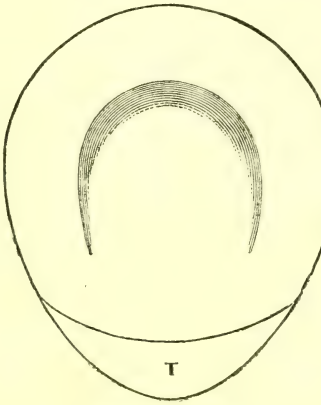
The mercury, by virtue of its comparatively good conducting power, acquires a uniform temperature throughout, which is indicated by the thermometer, and at the same time communicated to the fat. The fat when the temperature approaches its melting-point becomes partially transparent, and if the stem or elongated bulb of the thermometer be now brought up against it, the moment fusion takes place the liquid fat will run into the channel formed by the repulsion of the mercury and the outside of the thermometer tube. This process presents the following advantages:

(1) The heat-conducting power of the mercury, on which the fat is placed, ensures the equalisation of the temperature as indicated by the thermometer, and at the same time communicated to the fat.

(2) The direct contact of the fat with the mercury, without the intervention of a bad conducting medium, such as glass, ensures a more immediate and correct indication of the temperature at which liquefaction takes place than would otherwise occur.

(3) The minuteness of the quantity of fat operated upon reduces to a minimum the time occupied in its melting, and thus facilitates the determination with exactness of its melting-point.

(4) The time occupied in preparing small tubes and charging them with the fat is saved, and several experiments in succession may be easily and rapidly made with the same apparatus. The author observed that in butter as well as other fats, such as tallows, there were at least two melting-points, dependent upon the way in which the fat had been previously subjected to the action of heat, and that they may differ in butter to the extent of 3° or 4° F.; the low melting-



Butter-analysing dish.

point being that of the fat after it has been heated to several degrees above its first melting-point, and the higher melting-point being that of fat which has been previously melted to the lowest possible temperature, and then immediately allowed to congeal.

5. Professor Wanklyn carefully weighs 1 grm. of butter, and heats it in a platinum dish of the size shown in the accompanying figure, from 4 to 6 hours or even more—in short, until it ceases to lose weight. The loss of weight is the water, which should be calculated and expressed in percentages.

Fat. The dried butter is now to be heated with ether (the ether should be made to boil by floating the dish in hot water). Several successive portions should be taken, the whole passed through a filter, the filter well washed with ether, and the filtrate evaporated to dryness and weighed.

Caseine and Ash. The residue from which the fat and water have been extracted is now to be taken, carefully weighed, then burned down to a low red heat; the residue remaining is the ash, the loss the caseine.

The amount of ash, practically speaking, is the salt, but if there be any doubt as to its composition, the chlorine may be estimated by a volumetric solution of nitrate of silver, and further examined.

The following table shows the composition of a few genuine and other butters, examined according to the same, or at least to a similar process to the one described:

	Fat.	Ash, principally Salt.	Water.	Caseine.	Quality.	
Fresh Devonshire butter	82·7	1·1	16·2	16·2	Good	WANKLYN.
Normandy butter .	82·1	1·8	16·1	16·1	„	„
Jersey butter . . .	78·491	8·528	10·445	2·536	„	ANGELL and HEHNER.
Normandy butter .	82·643	2·915	9·305	5·137	„	„
Butter from Ventnor	86·280	6·600	3·831	3·289	Found to be adulterated with foreign fat	„
Butter from London	87·50	1·559	23·981	6·880	Adulterated with water	„
„ „	47·119	2·6810	42·358	7·834	Adulterated with water, and contains an excess of curd.	„

6. *A Method of detecting Meat Fats in Butter.* Mr Horsley, writing to the 'Chemical News,' September, 1874, says: "My starting-point is, that fresh butter is permanently soluble in methylated ether, sp. gr. 0·730 at the temperature of 65° F. But with the view of seeing if any other substance it may contain could be precipitated from it, I took, say, 20 or 25 gr. of fresh butter, placed it in a small test-tube, and poured over it 1 dr. of methylated ether, and on corking the tube it readily dissolved after a few minutes' agitation. I then added 30 drops of methylated alcohol, 63° o.p., and agitated again, but nothing was precipitated. I therefore made another experiment with 15 gr. of butter and 10 gr. of prepared mutton fat, dissolved them in 1 dr. of ether first, and added 30 drops of alcohol, when in less than half an hour the fat was precipitated in a room heated to 68° F. Next, in order to see the effects upon mixtures of known fats, such as lard, beef, mutton, and tallow fats properly melted together in proportions of 60 gr. of butter and 40 gr. of fat, and stirring till cold, I found that each of them could, by a similar procedure, be precipitated in a few minutes. In one case—that of mutton—I filtered off the ethereal liquid, and collected the residue, and obtained as much as 30 % of what had been used; so that there is no longer any doubt about easily detecting fatty adulterations in butter. Lastly, I would observe that crystallisation of butter, out of the ethereal solution at a lower temperature than 65° F., must not be mistaken for the fats precipitated by alcohol alluded to, as the butter, besides being so much lighter, occupies the upper layer, and is different in character and easily remelted by the application of the warm hand for a minute or so.

"Further experiments have proved that half an hour suffices to effect the full precipitation of fats from the ethereal solutions by the addition of 20 drops or so of alcohol to the dr. of ether, containing not more than 25 gr. of the adulterated butter; after which the tube should be agitated and its contents projected on to a small double filter, washed with a little alcohol, and the residue whilst moist scraped off and transferred to a watch-glass to dry. In this way loss by melting and absorption into the paper is obviated.

"The following were the proportions of fats I recovered, viz.:

Lard . . .	60 per cent.
Mutton fat .	75 „
Beef fat . .	95 „

The precipitated mutton fat is powdery, and white as snow. Lard and beef are more adherent and greasy; for that reason mutton makes the firmest compound."

7. *On the Cooling of Fats.* At a meeting of the University of Edinburgh Chemical Society, held on March 13th, 1878, a paper on the above subject was read by Mr Treharne, M.B.C.M., wherein the author states: "If equal bulks of the fats of mutton, beef, pork, and butter, and

palm oil be heated to 100° C. in small flasks fitted with a thermometer through the cork, and then allowed to cool by radiation under the same conditions for each, temperature is found to fall regularly to a certain point (which is different for each of the fats above named) and then to rise to a certain turning-point. These turning-points are approximately as follow:

For Mutton fat	. .	40·0° C.
„ Beef „	. .	28·5° „
„ Pork „	. .	26·5° „
„ Butter „	. .	23·5° „
„ Palm oil	. .	21·0° „

"The extent of the rise in temperature is different in each fat, being greatest in that of mutton and least in that of butter and palm oil. The extent of the rise is also greater within certain limits the greater the quantity of fat employed; but as a rule the turning point is pretty constant for the same fat. There is also a little difference in the turning-points and the extent of rise, according to the part of the carcass from which the fat has been taken. If temperature and time be taken as co-ordinates, and the rate of cooling be represented by curves, these latter will be characteristic of the respective fats. A mixture of equal parts of mutton and butter fats does not give a curve intermediate between those of its two components; but is such as to indicate that less heat is given out on cooling (to 20° C. say) than in the case of butter, which, compared with mutton fat, gives off very little heat."

For further information on the subject of 'Butter' the reader is referred to a Report by Mr Bell—the principal of the Chemical Laboratory at Somerset House—to the Board of Inland Revenue, included in a return made to the House of Commons in 1876.

Preservation. 1. Melt the butter in a stoneware or a well-glazed earthen pan set in a water-bath at a heat not exceeding 180° F., and keep it heated, skimming it from time to time until it becomes quite transparent; then pour off the clear portion into another vessel, and cool it as quickly as possible by placing the vessel in very cold water or ice. This is the method employed by the Tartars who supply the Constantinople market. In this state it may be preserved perfectly fresh for 6 or 9 months, if kept in a close vessel and a cool place. This is the plan so strongly recommended by M. Thénard. Mr Eaton states that butter melted by the Tartarian method and then salted by ours, will keep good and fine-tasted for two years.

2. Saltpetre and white sugar, of each, 1 *oz.*; best Spanish great-salt (or Cheshire large-grained salt), 2 *oz.*; all in very fine powder; mix thoroughly, and add 1 *oz.* of this mixture to every *lb.* of butter, and thoroughly incorporate them together. The butter thus prepared is then to be tightly pressed into clean glazed earthenware vessels (or well-seasoned casks), so as to leave no vacuities. This plan is recommended by Dr Anderson, who declares that "butter so prepared will keep in a cool place for many years; and will bear a voyage to the East Indies, if packed (stowed) so as not to melt." It does not taste well before it has stood for three or four weeks, after which it acquires a rich, marrow-like flavour, which no other butter ever possesses. A good method to preserve the butter from the air is to fill the pots to within an inch of the top, then to lay on it some coarse-grained salt to the depth of a $\frac{1}{4}$ to $\frac{1}{2}$ an inch, and lastly, to cover each pot with a slate, plate, or other flat article. The salt by long keeping runs to brine, which forms an air-tight layer on the top of the butter, and may at any time be very easily removed by turning the pot on one side.

3. Fresh butter, 21 *lbs.*; salt, 1 *lb.*; saltpetre, 1 *oz.* These are the common proportions for the best salt butter of the shops.

4. Fresh butter, 18 *lbs.*; salt, 1 *lb.*; saltpetre, $1\frac{1}{2}$ *oz.*; honey or fine brown sugar, 2 *oz.* Superior to No. 3.

Concl. Remarks. It may be useful to know that rancid butter may be restored, or, in all cases greatly improved, by melting it in a water-bath with some fresh-burnt and coarsely powdered animal charcoal (which has been thoroughly freed from dust by sifting), and straining it through clean flannel. A better and less troublesome method is to well wash the butter first with some good new milk, and next with cold spring water. Butyric acid, on the presence of which rancidity depends, is freely soluble in fresh milk.

The turnip-flavour arising from the cows being fed on turnips or cabbages is said to be removed by one or other of the following methods: 1. When the milk is strained into the pans put to every 6 galls. 1 gall. of boiling water. 2. Dissolve 1 *oz.* of nitre in a pint of spring water, and put a $\frac{1}{4}$ pint of the solution to every 15 galls. of milk. 3. Keep back a $\frac{1}{4}$ pint of the sour cream when you churn, and put it into a well-scalded pot, into which you are to gather the next cream; stir that well, and do so with every fresh addition. Each of these methods come on good authority, but we are bound to say that our own experience does not confirm their constant success. We have found that the addition of a handful of salt to the water used to wash the butter is as good a plan as any. See LARD.

Butter, Ancho'vy. From anchovies (boned and beaten to a paste), 1 part; butter, 2 parts; spice, q. s.

Butter, Clar'ified. Fresh butter melted in a water-bath, allowed to settle, and the clear portion poured into an earthenware basin or pot, set in cold water, so as to cool it as quickly as possible, without allowing it to crystallise. It keeps a long time without becoming rank. See BUTTER, No. 1 (*antè*).

Butter Colouring (from Paris). A mixture of 40% of chrome yellow with some fat coloured with annatto (*Flückiger* and *Weil*).

Butter, Hon'ey. Fine Narbonne honey, 2 to 4 *oz.*; mixed with good butter, 1 *lb.* Used as a delicacy for children, and by the sick and aged.

Butter, Lem'on. See BUTTER, ORANGE.

Butter, Melt'ed. This well-known sauce may be prepared of excellent quality as follows: Beat up about 1 *oz.* of fine flour with 4 *oz.* of butter, in the cold, until they are evenly and thoroughly mixed, then add 4 or 5 tablespoonfuls of hot milk, put the whole into a small saucepan, and continue shaking it, all in one direction, until it simmers very gently; lastly, remove it from the

fire, and pour it into the butter-boats for use. These last should be filled with hot water, and then emptied and wiped dry before putting the melted butter into them. See SAUCES.

Butter, Orange. *Prep.* 1. From 6 eggs, 2 *oz.* of powdered sugar, and 4 *oz.* of butter, well beaten together with a little orange-flower water. Sometimes 1 or 2 *oz.* of blanched almonds, or of almond-paste is added.

2. Butter, 1 *lb.;* syrup of orange peel, 4 *oz.* Both are eaten as a delicacy. LEMON BUTTER is made in a similar manner.

Butter of An'timony*‡. Trichloride of antimony.

Butter of Caca'o. See CO'COA and CO'COA-NUT OIL.

Butter of Nut'megs. Collected from the surface of the water in the still, after the distillation of the essential oil of nutmegs.

Butter of Ro'ses. Obtained by distilling damask roses. It separates slowly from the water in the receiver. It has little smell, and is hence used to dilute the odour of musk, ambergris, and civet.

Butter of Wax. Prepared by distilling beeswax. A factitious kind is also made.

Butter of Zinc*‡. Chloride of zinc.

Butternut Wood, Fruits, and Oil (*Juglans cinerea,* Linn.) of the United States.

Butter Powder (from the Adler-Apotheke Emmerich on the Rhine). Bicarbonate of soda (*Dr U. Kreusler*).

Butter Powder (*Lemmel,* Schleswig-Holstein). An impure bicarbonate of soda, coloured with turmeric (*Hirschberg*).

Butter Powder, Schührer's (*Emil Schührer,* Mutzschen, Saxony). This, it is claimed, will considerably increase the yield of butter, shorten the process of churning, and yield a product which will be firm even in the height of summer, well-flavoured, of a handsome colour, and of excellent commercial value. It consists of a tolerably pure commercial bicarbonate of soda, with ½% of powdered turmeric (*Dr Peters*).

Butter Powder, Tomlinson's (*Tomlinson & Co.,* Lincoln, England). Ordinary bicarbonate of soda, coloured with ⅘% of annatto (*Dr Karmrodt*).

Butter-preservative Paste (from Spaa). Consists of common salt, 52 parts; nitre, 23 parts; syrup, 5 parts (*Wittstein*).

Butter, Shea, Tree (*Butyrospermum Parkii,* Kotschy), growing in Western Africa, from the kernels of which a fat is obtained called Shea butter, and used as butter by the natives. Gutta Shea, a hydrocarbon obtained from the fat in the manufacture of soap, is present to the amount of from 5% to 75%. The milky juice of the tree when solidified is stated to have all the properties of gutta-percha.

Butter and Tallow Tree (*Pentadesma butyracea,* Br.), of Sierra Leone. So named from the yellow greasy juice which copiously flows from it when cut. It is mixed by the negroes with their food.

BUTTERINE. A substance known under this name, and intended as a substitute for butter, is imported into this country from New York.

Of butterine Dr Campbell Brown remarks: "In general appearance, taste, and consistence, it is very similar to ordinary butter; but notwithstanding that its solidifying point is lower than that of some butters, it retains much of the peculiar crumbly texture and fracture of dripping.

"It softens at 78° and melts at 86° F. When heated and slowly cooled it obscures the thermometer at 62° and solidifies at 60° F. It contains—

Water	11·25	to	8·5
Salt	1·03	„	5·5
Curd	0·57	„	0·6
Fat	87·15	„	85·4
	100·00		100·00

"The fat consists of oleine, palmitine, margarine, a trace of stearine, and about 5% or 6% of butter. When dissolved in about four times its weight of ether, and allowed to evaporate spontaneously, it does not deposit any fat until more than half of the ether has passed off; and if the temperature is not below 60° the deposit is solid.

"The first deposit when dried fuses at 108°, the second deposit fuses at 88°, and solidifies at 64° F.

"Under the microscope butterine does not appear to consist of acicular crystals of fat, but of irregular masses containing a few butter globules, particles of curd, and crystals of salt. With polarised light the irregular crystalline structure is beautifully seen, and is clearly distinguishable from butter which has been melted and recongealed. When old and rancid it acquires the odour and taste of dripping, but it keeps longer undecomposed than butter. When fresh it is a wholesome substitute for real butter. No one can reasonably take exception to its sale.

"Butterine may be detected by the following characters:

"1. Its crumbly fracture.

"2. Its loss of colour when kept melted for a short time at 212° F.

"3. The behaviour of its ethereal solution.

"4. Its action on polarised light."

(Mr Henry Mott on the manufacture of artificial butter.) See MARGARINE.

BUTTERMILK. The liquid that remains after the butter is separated from the cream.

Qual., &c. Buttermilk left from the churning of sweet cream is not only very delicious, but exceedingly wholesome and nutritious. It is eaten with fruit, puddings, and cakes, and is said to possess the property of allaying the nervous irritability induced by excessive tea-drinking. It is an admirable beverage in rickets, diabetes, and many stomach affections. An American physician has recently asserted that it induces longevity. See MILK.

BUTTONS. See BRASS, GILDING, &c.

BUTYL CHLORAL. *Syn.* CROTON CHLORAL, wrongly so called, $C_4H_5Cl_3O_2$. A colourless oleaginous liquid, having an odour somewhat like that of ordinary chloral; insoluble in water. Butyl chloral may be prepared by the process of Krämer and Pinner, who were the first to obtain it. A current of chlorine gas is passed into aldehyde during 24 hours. At the commencement of the operation the action is very energetic, so much so that it is necessary to surround the vessel containing the aldehyde with a refrigerating

mixture, and it is only towards the end that the temperature is raised to 100° C. Large quantities of hydrochloric acid are generated during all the time the chlorine is acting on the aldehyde. The resulting product is submitted to fractional distillation, and the liquid passing over between 163° and 165° C. is croton chloral. Like ordinary chloral, butyl chloral combines with water to form a crystallised hydrate which is the substance used in medicine. Butyl chloral hydrate occurs in white nacreous spangles. It is very slightly soluble in cold water, more so in warm, and extremely soluble in alcohol. A convenient solvent for it is glycerin, in which it dissolves much more easily than in water. The dose of the hydrate as an hypnotic is from 8 to 15 gr., for neuralgia 5 gr. are given three times a day. Dr Liebreich, who first introduced butyl chloral to the notice of the medical profession, says he has failed to discover that it exercises any hurtful effects on the stomach and other organs. On the contrary, Dr Worms asserts that he finds it not so generally tolerated as ordinary chloral, and Gay affirms that it is more uncertain in its narcotic effects.

BUTYRATE. [Eng., Fr.] *Syn.* BUTYRAS, L. A salt of butyric acid (which *see*).

BUTYRIC. *Syn.* BUTYRICUS, L.; BUTYRIQUE, Fr. Of or from butter.

BUTYRIC ACID. $C_4H_8O_2 = C_3H_7CO_2H$. *Syn.* ACIDUM BUTYRICUM, L.; ACIDE BUTYRIQUE, Fr.; BUTTERSÄURE, Ger. Occurs in butter (see BUTYRIN) and in many vegetable and animal juices and oils.

Prep. By the fermentation of sugar. 6 kilogrms. of sugar and 30 grms. of tartaric acid are dissolved in 26 litres of boiling water, and, after some days 250 grms. of putrid cheese mixed with 8 kilogrms. of sour skimmed milk are added together, as well as 3 kilogrms. of finely-divided chalk. The mixture is kept at 30°—35° C. (86°—95° F.) and stirred up every day; after about a week it becomes a thick magma of calcium lactate $(C_3H_5O_3)2Ca$. It is then allowed to stand longer at 35° C. (95° F.), the whole again becoming liquid, and an evolution of carbonic acid taking place, which lasts for several weeks. During the process the water, as it evaporates, must be from time to time renewed. When the evolution of carbonic acid has ceased more water is added, and 8 kilogrms. of crystallised carbonate of soda; the solution is filtered from calcium carbonate, evaporated to 10 kilogrms., and treated with 11 kilogrms. of dilute sulphuric acid. An oily layer of butyric acid rises to the surface, and must be separated from the aqueous liquid and purified by distillation, and by standing over calcium chloride.

Prop. A thin colourless liquid, with an acid taste and rancid smell. It boils at 162° C. (324° F.), has a sp. gr. of 0·960, and mixes with water and alcohol in all proportions.

Salts. These are unimportant; they are insoluble, or only slightly soluble in water; except those of the alkalies and of magnesia, which are soluble. *Calcium butyrate* is formed by the fermentation of calcium lactate, as in the process described above; when treated with sulphuric acid it yields butyric acid.

BUTYRIN. [Eng., Fr.] A glycerine ether of butyric acid, *i. e.* a compound of butyric acid and glycerine. It was discovered by Chevreul in butter, which contains about 2% of it. It is a neutral liquid, with a sharp bitter taste, and is decomposed by potash into glycerine and potassium butyrate.

BUXINE. An alkaloid discovered by Faure in the leaves of the common box tree (*Buxus sempervirens*).

BYTURUS TOMENTOSUS (*tomentosus*, covered with down), Fabricus. The Raspberry Beetle. Raspberries are largely produced in many of the fruit districts of this country, and their cultivation increases, and should increase seeing that they are very profitable, because they are perishable, being so soft and juicy, and cannot therefore be readily imported. There is also much land either that is now cultivated at a loss, or that is going out of cultivation, which might be most advantageously devoted to the production of this useful fruit.

There are several insects that affect this fruit, and are described fully in their proper order in this work. But there are none which prove more serious enemies to it than the insect known scientifically as the *Byturus tomentosus*, and vulgarly as the Raspberry bug. This has been known to gardeners for many years as a foe to raspberries; but it is only recently, by comparison, that its action upon this fruit has been manifest to the producers upon a wholesale scale in large plantations.

The beetle begins its mischievous work by biting the leaves and piercing the young flower buds through and through, much in the same manner as the *Otiorynchus picipes*. Then it deposits its eggs in the forming fruit-buds, from which larvæ come and feed upon and spoil the fruit.

In the 'Introduction to British Entomology' it is stated that "when raspberries are in flower the footstalks of the blossoms are occasionally eaten through by a minute animal, *Byturus tomentosus*, which I once saw prove fatal to a whole crop, and of which the larva feeds upon the fruit itself" ('Introduction to British Entomology,' by Kirby Spence, p. 109). Curtis also alludes to this, remarking that "it is to this insect that I attribute the not infrequent failure of our raspberry crop, the greater part of which is thus often injured or destroyed" ('British Entomology,' by J. Curtis).

Blackberry canes are also preyed upon in a similar manner by this beetle, and it may be frequently found upon brambles or wild blackberry plants, and upon the common hawthorn.

There is an insect of the same species, or of a closely allied species, described by Professor Saunders as very injurious to raspberry and blackberry plants in America and Canada. From accounts received from a correspondent in the central part of France it appears that the blossoms and fruit of raspberry plants suffer considerably from a beetle whose description agrees with that of the *Byturus*.

Taschenberg and Kaltenberg both speak of this insect as infesting raspberry and blackberry plants in Germany.

Life History. The *Byturus tomentosus* is of

the order COLEOPTERA, and is placed by Westwood in its family *Nitidulidæ*. Curtis holds that it should be included in the family *Dermestidæ*, and Stephens puts it among the *Engidæ;* but, as usual, Westwood's classification appears to be the most rational.

It is close upon the 1-6th of an inch, or 2 lines, in length, of a dark brown colour, having its body covered with a pubescence or down. It has wings of full size, and its six feet and its antennæ are buff coloured.

Towards the early part of May the beetles may be found upon the raspberry and blackberry canes busily engaged in biting through the flower-buds at their bases, or in feeding upon their shoots. As the fruit-buds come out the females place their eggs singly within them; these produce larvæ or grubs just at the period when the fruit is formed, which at once commence feeding upon it, either spoiling it entirely or reducing the number and size of its carpels, as shown in the figure given above of the raspberry grub at work. Cultivated blackberry plants are attacked in a precisely similar manner, and it is very common for those who incontinently pluck wild blackberries and put them into their mouths to find that they have been swallowing grubs wholesale.

The larva or grub is yellowish, with a dark coloured head and dark marks upon its body. The head is depressed or flattened peculiarly. It is close upon ½ an inch in length, has six legs and a rudimentary leg at the extremity of its body, from which two dark coloured sharp curved points project.

When this grub has despoiled the fruit on which it has been reared, it either falls to the ground and hides in it, or, as Taschenberg states, it gets into rifts in the stems of the plants or of the canes, and changing soon into a chrysalid, remains in this form throughout the winter. Miss Ormerod agrees with this statement of Taschenberg.

Prevention. Careful autumn and early spring digging and hoeing the ground, especially near the raspberry stocks, would tend to disturb or kill the chrysalids. At the same time paraffin-soaked substances, or other noxious or caustic substances might be dug or hoed in.

It is most essential that all weed-growth should be cleared from the ground during the summer, so that there may be no harbour for the grubs. Also that when the canes are cut or pruned in autumn all the cuttings should be carefully picked or raked off, and carried away or burned. Growers do wrong to allow the cuttings of any fruit trees to remain upon the ground, particularly after an attack of any kind of insect.

Remedies. If it were seen in the early spring that the beetles were numerous upon the canes, the plan of catching them with tarred boards held between the rows of plants while these were smartly tapped might be adopted.

This is practised with success in the case of the *Otiorynchus picipes*, as shown in a succeeding monograph ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CABBAGE. *Syn.* BRAS'SICA, L.; CHOU, Fr.; KOHL, Ger. This common esculent, and all its numerous varieties, are merely cultivated specimens of the wild sea-cabbage of our coasts (*Bras'sica olera'cea*, Linn.), one of an extensive and valuable genus of plants belonging to the Nat. Ord. CRUCIFERÆ. After the potato, the cabbage is doubtless more extensively used by the masses of the people than any other fresh vegetable. When young, and properly dressed, it forms an agreeable and wholesome addition to animal food. It should be eaten only when freshly gathered and freshly cooked; and the unconsumed portion, as well as the water in which it has been boiled, should be at once thrown away. Persons troubled with a weak digestion, or who have a tendency to flatulence, diarrhœa, or worms, would do well to avoid them. Their use is particularly serviceable in scurvy, and in numerous skin diseases.

It has been asserted that cabbages, cauliflowers, broccoli, celery, and several other culinary vegetables, may be preserved in a fresh state for some time by cutting them so that they may have about two inches of stem left below the leaves, scooping out the pith as far down as a small knife will reach, and then suspending them perpendicularly by means of a cord, in an inverted position, in some cool situation, and daily filling up the bottom part of the stem with clean cold water. In this way it is stated that a supply of green vegetables may be readily obtained during a severe winter and on shipboard. Other methods, including those usually adopted with the same object, are noticed under VEGETABLES (Culinary).

Cabbages, broccoli, &c., are dressed by simply throwing them into boiling water, and simmering them until tender. A few minutes is sufficient for this purpose. A pinch of salt of tartar, or of carbonate of soda, is commonly added to the water, to preserve the green colour of the vegetables. See BRASSICA.

CACHOU AROMATISE (kăshoo ărōmătēzā). [Fr.] A mouth-lozenge intended to sweeten and perfume the breath. Preparations of this description are much used by smokers and bacchanals. The form under which they are generally prepared for sale is that of 1½ to 2 gr. pills, neatly silvered. Originally they were composed chiefly of catechu and sugar, flavoured and perfumed with the stronger aromatics; but at the present day the catechu, from which they derive their name, is not unfrequently omitted. Their preparation is described elsewhere. See BREATH, LOZENGES, PASTILS, &c.

CADMIUM. Cd = 112. [Eng., L., Fr., Ger.] A metallic element, belonging to the same group as magnesium and zinc, which elements it much resembles.

Source. Compounds of this element occur in various ores of zinc, especially in the Silesian ores. The quantity of cadmium varies from 1·5% to 3%.

Prep. In the process of zinc-smelting (see ZINC) the more volatile vapour of cadmium comes off with the first portions of the zinc, and these vapours burn in the air with formation of the oxides of cadmium and zinc. The powder thus deposited is then mixed with coal and the mixture heated in iron tubes, when the cadmium distils over first. In order to purify it the metal is re-

distilled, and the second product dissolved in hydrochloric acid, from which solution the cadmium is precipitated with metallic zinc.

Prop. Cadmium is a very lustrous metal, tin-white, with a slight bluish tinge, and capable of taking a high polish. It is somewhat harder than tin, but may be cut with a knife. Its fracture is fibrous, and it can be easily rolled out into foil and drawn into wire. It crystallises readily in octahedrons. Its sp. gr. is 8·65 when cast, 8·8 after hammering. It melts at 320° C. (608° F.), and boils at 770° C. (1418° F.). Its vapour has a dark yellow colour and a disagreeable smell, producing headache when inhaled. Alloys of cadmium, especially those with lead, tin, and bismuth, are remarkable for their low melting-points (see FUSIBLE ALLOYS and BISMUTH). Cadmium oxidises slowly on the surface when exposed to the air, and when heated in air it burns to the oxide; it decomposes water at a red heat.

Tests. 1. Heated on charcoal with sodium bicarbonate in the reducing flame of the blowpipe, salts of cadmium are reduced to the metal, but this volatilises, and in passing through the oxidising flame becomes oxidised, and forms a brown incrustation of cadmium oxide on the charcoal. 2. Solutions of cadmium salts, if not too strongly acid, give with sulphuretted hydrogen a yellow precipitate of cadmium sulphide, which is insoluble in dilute acids, alkalies, and alkaline sulphides and cyanides, but dissolves in strong nitric and hydrochloric acids, especially when warmed, and in hot dilute sulphuric acid. Solutions of arsenites and of stannic and antimony salts also give yellow or orange precipitates with sulphuretted hydrogen, insoluble in dilute acids; but these, unlike cadmium sulphide, dissolve in a solution of ammonium sulphide. 3. Cadmium and copper hydroxides are both soluble in ammonia, and hence these two metals are frequently obtained together in the process of analysis. To separate them potassium cyanide is added to the blue ammoniacal solution until this becomes colourless; sulphuretted hydrogen is then passed into the solution, when the cadmium sulphide is completely precipitated. The presence of copper is shown by the deep blue colour of the ammoniacal solution. Another method is to precipitate the two sulphides together by means of sulphuretted hydrogen, and then boil them with a mixture of 5 parts of water and 1 of strong sulphuric acid, in which the cadmium sulphide dissolves, leaving the copper sulphide as a black insoluble residue.

Estim. 1. Cadmium carbonate is formed as a white precipitate by adding potassium carbonate to the solution of the cadmium salt; this precipitate is collected, washed, dried, and converted by ignition into the oxide, in which state it is weighed. The weight of the oxide multiplied by 0·875 gives the weight of cadmium in the portion of the substance examined. 2. Sulphuretted hydrogen is passed into the solution, which should be slightly acid with hydrochloric acid; the resulting yellow precipitate of sulphide is collected, dried at 100° C. (212° F.), and weighed; its weight multiplied by 0·777 gives the weight of cadmium it contains. For separation of cadmium from copper, see under *tests*. If zinc be present, tartaric acid must be added before method 2 is used; on adding the alkali the zinc then remains dissolved. When a solid cadmium compound has to be examined it can always be dissolved in hydrochloric or nitric acid, if not in water.

Salts. Cadmium forms only one series of salts corresponding to the oxide CdO. This is the only oxide known, and all the salts of cadmium may be prepared from it by dissolving it in the suitable acids. The common salts of cadmium, except the sulphide, carbonate, hydrate, and oxide, are soluble in water, giving colourless solutions.

Cadmium, Carbonate of. $CdCO_3$. *Syn.* CADMII CARBONAS, L. A white precipitate formed by adding potassium carbonate to a solution of cadmium sulphate or chloride, and drying this precipitate at a gentle heat. It always contains some oxide mixed with it, and dissolves in all acids, giving the corresponding salts.

Cadmium, Chloride of. $CdCl_2$. *Syn.* CADMII CHLORIDUM, L.; CHLORURE DE CADMIUM, Fr.; CADMIUMCHLORID, Ger. *Prep.* By dissolving the metal or its oxide or carbonate in hydrochloric acid, and evaporating the solution. It is thus obtained in rectangular prisms, containing 2 molecules of water; these effloresce when exposed to the air, and lose all their water at a temperature below a red heat; they are very soluble in water.

Cadmium, Iodide of. CdI_2. *Syn.* CADMII IODIDUM, L.; IODURE DE CADMIUM, Fr.; CADMIUMIODID, Ger. *Prep.* By dissolving cadmium oxide in hydriodic acid, or by digesting cadmium with iodine under water or alcohol, and in either case filtering and evaporating the solution. The iodide is thus obtained in large, transparent, six-sided tables, which are anhydrous, and do not change when exposed to the air. It melts easily, and is very soluble in water and alcohol.

Uses. Owing to its solubility in alcohol, it is used in photography to iodise collodion; the solution preserves its sensitiveness undiminished for a long time (see COLLODION). Since the introduction of gelatine plates in photography, cadmium iodide is not so much used for this purpose as formerly. In *medicine*, it is used occasionally as a substitute for lead iodide.

Cadmium, Oxide of. CdO. *Syn.* CADMII OXYDUM, L.; OXIDE DE CADMIUM, Fr.; CADMIUMOXYD, Ger. *Prep.* By igniting the hydroxide, carbonate, or nitrate, or by burning the metal in air; it is obtained, mixed with zinc oxide, by this last method in the manufacture of zinc, forming the 'brown blaze' of the zinc-smelters. It is a brown powder, insoluble in water, but easily soluble in acids.

The hydroxide (hydrated oxide), $Cd(OH)_2$, is obtained by adding a soluble salt of cadmium to caustic potash, and gently drying the precipitate formed. It is a white powder, easily soluble in acids.

Cadmium, Sulphate of. $CdSO_4$. *Syn.* CADMII SULPHAS, L.; SULPHATE DE CADMIUM, Fr.; CADMIUMSULFAT, Ger. *Prep.* By dissolving cadmium or its oxide in a quantity of sulphuric acid not quite sufficient to dissolve it all, filtering off the solution from the undissolved residue, evaporating it, and allowing it to crystallise.

Prop., &c. Efflorescent, rectangular, prismatic crystals; very soluble in water; tastes astringent. It is about 4 times as strong as sulphate of zinc, and is used in similar cases.—*Dose*, 3 to 10 gr.

Externally ($\frac{1}{2}$ to 3 or 4 gr. to water, 1 oz.), in specks of the eye, opacity of the cornea, chronic ophthalmia, &c. As an ointment, 10 to 12 gr. to lard, 1 oz.

Cadmium, Sulphide of. CdS. *Syn.* CADMIUM YELLOW; SULPHIDE DE CADMIUM, Fr.; CADMIUMSULFID, Ger. This substance occurs native as the somewhat rare mineral, GREENOCKITE, in Renfrewshire, Bohemia, and Pennsylvania.

Prep. 1. On the small scale, by passing sulphuretted hydrogen into a solution of calcium.

2. On the large scale, cadmium nitrate is converted into the sulphide by the action of sodium thiosulphate. A steam-yellow with starch is obtained thus: 1 litre of water, 160 grms. wheaten starch, and 40 grms. of burnt starch are boiled together and mixed hot with 350 grms. of sodium thiosulphate. On cooling, 350 grms. of finely powdered cadmium nitrate are mixed in. Or a mixture is made of 1800 grms. gum tragacanth, 480 grms. cadmium nitrate, 800 grms. sodium acetate, 250 grms. flowers of sulphur, and 250 grms. arsenious acid (*Schmid*). These mixtures are used in calico-printing; the material is printed with them and then steamed, the action of the steam causing the formation of yellow cadmium sulphide where the pattern has been stamped upon the fabric.

Prop., Uses, &c. It appears to exist in two modifications which are convertible into each other, one a pure lemon-yellow, the other a full minium red. The reason of the great variation in the shade of commercial cadmium yellow is probably that the pigment consists of mixtures of these two modifications in varying proportions. Cadmium sulphide is used as an artist's colour, and lately, owing to a reduction in its price, it has come into use in calico-printing.

Cadmium Yellow. See CADMIUM, SULPHIDE OF (*above*).

CÆSALPINA (GUILANDINA) BONDUCELLA. (Ind. Ph.) *Habitat.* Tropical portions of both hemispheres.—*Officinal part.* The seeds (*Bonducellæ semina, Bonduc seeds*) are of a somewhat irregular subspherical or ovoid form, usually from $\frac{5}{8}$ to $\frac{6}{8}$ of an inch in diameter, smooth, hard, and lead-coloured, and contain an amylaceous white nucleus, having a bitter taste. They contain a fixed oil, resin, and a bitter principle.—*Properties.* Tonic and antiperiodic.—*Therapeutic uses.* In intermittent fevers; also in debility, and other cases requiring tonics.—*Dose,* 10 to 15 gr. twice daily.

COMPOUND POWDER OF BONDUC (*Pulvis Bonducellæ compositus*). Take of bonduc seeds, deprived of their shells and powdered, 1 oz.; black pepper, powdered, 1 oz. Mix thoroughly, and keep in a well-stoppered bottle.—*Dose,* 15 to 30 gr. three times a day.

CÆSIUM. [Eng., L., Fr., Ger.] A rare metallic element belonging to the group of the alkali metals, together with lithium, sodium, potassium, and rubidium.

Source. It occurs, together with rubidium, very widely distributed, but in excessively small quantities, and chiefly as the chloride and oxide. It is found in many mineral waters: for example, the Wheal Clifford Spring, in Cornwall, which contains 1·71 milligr. of cæsium chloride per litre, and in the ash of tobacco, tea, coffee, oakwood, &c. The oxide forms 34% of the rare mineral *pollux* found in Elba.

Prep. By the electrolysis of a fused mixture of cæsium and barium cyanides; the globules of the metal thus obtained are fused together under petroleum.

Prop. A silver-white soft ductile metal, melting at 26° C. (79° F.), and of sp. gr. 1·88. It oxidises rapidly in air with the production of heat and light, and decomposes water at the ordinary temperature, with inflammation of the hydrogen produced. Its spectrum contains two characteristic lines in the blue, whence its name, from *cæsius* = sky-blue.

Salts. It forms salts analogous to and resembling those of potassium; they are colourless, and mostly soluble in water.

CAFFE'IC ACID. *Syn.* CHLOROGE'NIC ACID. A white powder, discovered by Runge in coffee, in which it exists in combination with potassium (caffeiate of potassium) and caffeine, and is then very soluble in alcohol. Pfaff states that the aroma of coffee is dependent on the volatilisation, or rather, the decomposition of this acid.

CAFFEINA CITRAS EFFERVESCENS. Effervescing citrate of caffeine. Caffeina, 40 parts; citric acid, 40 parts; bicarbonate of sodium, 600 parts; tartaric acid, 540 parts; white sugar, 600 parts. Well dry the ingredients, and mix into a soft paste with rectified spirit. Heat gently, and drive off the spirit quickly, then reduce to a granular form.

CAF'FEINE. $C_8H_{10}N_4O_2,H_2O$. *Syn.* CAFFE'INA, THÉINE, GUARANINE. A peculiar nitrogenised principle, discovered by Robiquet in coffee. It is, moreover, the essential principle of tea, of Paraguay tea, of kola nuts, and of guarana, infusions of which are used as beverages in different parts of the world. The proportion of caffeine to the pound was found by Liebig to be as stated below in the six descriptions of coffee named:

Martinique	32 gr.
Alexandrian	22 ,,
Java	22 ,,
Mocha	20 ,,
Cayenne	19 ,,
St Dominique	16 ,,

In Hyson tea it exists in the proportion of from 2·5% to 3·4%; and in gunpowder tea from 2·2% to 4·1%. In Paraguay tea, or *maté*, as it is called in Brazil and in Guarana, it exists in the proportion of 5%.

Dr B. H. Paul ('Pharm. Journ.,' 1887) examined the following varieties of coffee, the result being a fairly constant yield of caffeine:

	Caffeine per cent.
Coorg	1·10
Guatemala	1·18
Travancore	1·16
Liberian	1·20
,,	1·28

The experiments were made with unroasted coffee. As a general rule, the amount of caffeine in pure roasted coffee is about 1·3%.

Prep. 1. (*Dr Paul.*) Mix finely powdered coffee with moist lime and exhaust with boiling alcohol, evaporate off the alcohol, mix the dry residue with some water and a few drops of

dilute sulphuric acid. The liquid is now filtered to free it from fat, and finally shaken with chloroform; on removing the chloroform and evaporating the caffeine is ready for weighing.

2. Coarsely powdered raw or unroasted coffee is boiled in water, and subacetate of lead added to the filtered decoction to throw down the extractive and colouring matter; the excess of lead is next precipitated with sulphuretted hydrogen, and the liquid filtered and evaporated by a gentle heat; the residuum is dissolved in boiling water, the solution agitated with freshly burnt animal charcoal, filtered, evaporated, and crystallised. By redissolving the product in hot alcohol, it may be obtained in white, shining, silky filaments as the solution cools.

3. (*H. J. Versman.*) Quicklime, 2 lbs.; water, q. s. to form a hydrate; raw coffee (bruised), 10 lbs.; mix, put it into a displacement apparatus, and cause alcohol of 80% to percolate through the mixture, until the fluid obtained no longer contains caffeine; the mass in the percolator is then roughly ground to powder, mixed with a fresh quantity of quicklime, and the process of percolation repeated with fresh alcohol as before. The spirit is next distilled from the mixed tinctures in a retort, and the residuum washed with a little warm water to remove the oil; the evaporation is then gently conducted until a crystalline mass is obtained, which is further freed from adhering oil by pressure between folds of blotting-paper. It is purified by redissolving it in boiling water or hot alcohol, &c., as before.

4. (*F. V. Greene.*) Powdered guarana is intimately mixed with three times its weight of finely divided litharge, and the mixture boiled in distilled water, the ebullition being continued until, on allowing the temperature to fall below the boiling-point, the insoluble portion is found to subside rapidly, leaving the supernatant liquid clear, bright, and without colour. The quantity of distilled water required will be found to be about a pint for every 15 grms. of the guarana used in the experiment, and as the boiling has to be continued for several hours before the desired and all essential separation mentioned above takes place, water must be added from time to time to supply the place of that lost by evaporation. When cool, the clear liquid is decanted upon a filter, and when it has passed through, which it will be found to do with facility, the precipitate is to be transferred to the filter, and washed with boiling water, the washing to be continued as long as yellowish precipitates are produced with either phosphomolybdic acid solution, auric, or platinic chloride. A stream of sulphuretted hydrogen gas is now passed through the filtrate to remove the small quantity of lead that has been dissolved, and the sulphide thus formed separated by filtration. The solution is evaporated on a water-bath to expel the excess of sulphuretted hydrogen, filtered to remove a trace of sulphur, finally evaporated to the crystallising point, and the caffeine which crystallises out in cooling removed from the mother liquor and pressed between folds of bibulous paper. After being thus treated the crystals will be found to be perfectly white. On diluting the mother liquid with distilled water, filtering, and evaporating, a second crop of crystals are obtained, which are also perfectly white after being pressed as above. The crystals are now dissolved in boiling dilute alcohol, filtered, and the solution set aside to crystallise by spontaneous evaporation. The resulting crystals of caffeine are perfectly pure and colourless.

5. (*O. Caillol* and *P. Cazeneuve.*) The following is a process for the rapid preparation of caffeine: Black tea is thoroughly softened with four times its weight of hot water; a quantity of calcium hydrate equal to that of tea used is then added, and the whole evaporated on a water-bath to perfect dryness. The dry residue is exhausted with chloroform in a displacement apparatus, and the chloroform recovered from the percolate by distillation. The residue left in the retort is a mixture of caffeine and a resinous substance containing chlorophyll. On treating it with hot water, filtering and evaporating the filtrate on a water-bath, the caffeine is obtained in perfectly white crystals.

Characters and Tests. Colourless, silky crystals. Soluble in 70 parts cold water; the solution is neutral to litmus, and of a faintly bitter taste. Freely soluble in chloroform and alcohol. It unites with acids to form salts of a weak character and acid reaction. Treated with a crystal of chlorate of potassium and a few drops of hydrochloric acid, and the mixture evaporated to dryness in a porcelain dish, a reddish residue results, which becomes purple when moistened with ammonia. It forms fine double crystalline salts with platinic or gold chlorides.

Uses. Tonic and restorative to the nervous system; stimulates the heart, and raises arterial tension. Given in nervous sick headache; also as a diuretic in cardiac dropsy, sometimes used as an antidote to opium. Large doses cause rise of temperature, convulsions, and paralysis.—*Dose*, 2 to 6 gr.

Caffeine, Citrate of. Caffeinæ Citras, $C_8H_{10}N_4O_2$, $C_6H_5O_7$. A weak compound of citric acid and caffeine. Take of caffeine, 1 oz.; citric acid, 1 oz.; water, 2 oz.; mix, dissolve with heat, and evaporate to dryness.

Prop. and Uses. A white powder of acid reaction. With a little water it forms a clear fluid, which on further dilution gives a white precipitate of caffeine, which redissolves when 30 parts of water have been added. Uses the same as caffeine, but often preferred as being more soluble.—*Dose*, 2 to 10 gr.

CAF′FEONE. A brown aromatic oil, formed during the roasting of coffee.

CAJ′EPUT OIL. See Oils (Volatile).

CAKES. A species of fancy bread or trifle familiar to every one.

Before proceeding to the actual operation of cake-making, the various materials which are to enter into their composition undergo a certain amount of preparation. For this purpose every article is got ready about an hour previously to its being wanted, and is placed before the fire, or upon a stove, that it may become gently heated. Without these precautions it is impossible to produce good cakes. The flour is thoroughly dried and warmed. The currants are nicely washed in a hair sieve, wiped dry in a cloth, and

then set before the fire. Before use they are dusted over with a little flour. The sugar is rubbed to a fine powder, and passed through a sieve. The eggs are well beaten in a basin, and strained. The butter is melted by being placed in a basin set in hot water, and is afterwards well beaten up with a little warm milk. The lemon peel is cut very thin, and beaten in a mortar to a paste or powder, with lump sugar; or for common purposes it is grated. The caraways, ginger, and other flavouring ingredients are preferred in the form of fine powder, or are made into an essence by digesting them in spirit of wine; the first is the most common method. The milk and water is made lukewarm. When all these things are ready and have stood a sufficient time, they are put into a pan one after another, in the proper order, and well beaten together, by which the lightness of the cakes is considerably increased.

In plum cakes, as well as in some other varieties, a little yeast may be added after the butter, and the mass allowed to rise a little, and then again well kneaded, by which not only less butter and eggs may be used, but the products will be both lighter and more wholesome. Good stale bread, well soaked in hot milk or water, and then beaten to a paste and passed through a fine sieve, forms an excellent thing to mix up the ingredients with, and produces a very light and nutritious cake. Cakes 'wetted up' with milk are richer, but do not keep so well as those without it; they get stale sooner, and when in that state are far from agreeable to the palate. A kind of flour prepared from maize or Indian corn has been recently introduced to the notice of cooks, but it is better adapted for puddings than for cakes. See CORN-FLOUR.

Cakes are preferably baked on flat tins or in little 'tin shapes,' which should be first well buttered.

Cakes should be kept for store in tin canisters; wooden boxes, unless very well seasoned, are apt to give them an unpleasant taste. Brown paper linings and wrappers should be avoided for the same reason. See BISCUITS, BREAD, BUN, ICING, STAINS, &c.

Cakes, Al'mond. *Prep.* 1. From sweet almonds (blanched and beaten to a smooth paste), flour, and powdered sugar, of each, ½ lb.; 7 eggs, and the outside peel of 4 lemons (shredded small). The almonds, sugar, lemon peel, and eggs are beaten together until as white as sponge paste; the flour next worked in, and the paste put into buttered moulds and baked in a slack oven, with 8 or 10 thicknesses of white paper under them and one or two over them.

2. Almonds, 1 *lb.*; sugar, ½ *lb.*; rose water or orange-flower water, ¼ pint; flour, ¾ *lb.*; 3 eggs; as above. Some persons ice these cakes.

Cakes, Ban'bury. *Prep.* From butter and dough fermented for white bread, of each, 1 *lb.*, as in making puff paste, then rolled out very thin, and cut into oval or triangular pieces or other shapes. On these are placed a mixture of currants and moist sugar, equal parts, wetted with a little wine or brandy, and the paste being closed up, they are placed on a tin with the closed side downwards, and baked. A little powdered sugar, flavoured with candied peel (grated), or essence of lemon, is sifted over them as soon as they come out of the oven. In the common cakes of the shops the brandy is omitted, and lard is used for butter, but less of it.

Cakes, Bath. *Prep.* From butter, ½ *lb.*; flour, 1 *lb.*; 5 eggs, and a cupful of yeast; when risen, add powdered sugar, 4 *oz.*, and caraways, 1 *oz.* Bake them on tins.

Cakes, Cheese. *Prep.* 1. Curdle some warm new milk with rennet, drain the curd in a linen bag, and add ¼ of its weight, each, of sugar and butter, 6 eggs, some grated nutmeg, and a little orange-flower or rose water.

2. (*Almond Cheese Cakes.*) To the above add as much blanched almonds, beaten to a smooth paste, as there is butter, and an equal weight of macaroni.

3. (*Lemon Cheese Cakes.*) To the first form add lemon peel (grated fine), or essence of lemon, q. s.

Cakes, Di'et. *Syn.* DIET BREAD. *Prep.* 1. Dissolve sugar, 1 *lb.*, in milk, ½ pint; add 6 eggs, and whisk the mixture to a full froth, then cautiously stir in flour, 1 *lb.*, beat it for ¾ hour, and immediately bake it in a quick oven. It may be baked whole or divided into small cakes.

2. From fine flour and powdered sugar, equal parts; 6 eggs; and the juice and rind (grated) of 1 lemon.

Cakes, Drop. *Prep.* Eggs, 1 dozen; rose water, 1 tablespoonful; powdered sugar, ½ *lb.*; fine flour, ½ *lb.*; and caraways, ½ *oz.* Drop it on wafer-paper, and bake as before.

Cakes, Gin'ger. *Prep.* Sugar, 1 *lb.*; powdered ginger, 4 *oz.*; flour, 2 *lbs.*; water, 1 pint; butter, ½ *lb.*; candied orange peel, 8 caps (grated).

Cakes, Lem'on. *Prep.* Flour and sugar, of each, 1 *lb.*; eggs, 1 dozen; grated peel and juice of 4 lemons; whisk the eggs to a bright froth; then gradually add the rest.

Cakes, Marl'borough. *Prep.* Beat 8 eggs and 1 *lb.* of pounded sugar ¾ hour; then add fine flour, 1 *lb.*, and caraway seeds, 2 *oz.*

Cakes, Plain. *Prep.* 1. From flour, 4 *lbs.*; currants, 2 *lbs.*; butter, ½ *lb.*; caraway seeds, ¼ *oz.*; candied lemon peel (grated), 1 *oz.*; yeast, ¼ pint; milk, q. s. Let it rise well before baking.

2. Baker's dough, 2 *lbs.*; currants, 1 *lb.*; butter, ¼ *lb.*; 3 eggs; milk (hot), ¼ pint.

3. (*Rundell.*) Baker's dough, 4 *lbs.*; butter and moist sugar, of each, ¼ *lb.*; caraway seeds, a small handful. Well work it together, pull it into pieces the size of a golden pippin, and work it together again. This must be done three times, or it will be in lumps, and heavy when baked.

4. (Rich.) Equal weights of flour, butter, sultana raisins, eggs, currants, and brown sugar, mixed up with milk, and seasoned with candied peel, nutmeg, &c., and baked in a quick oven. This resembles 'pound cake.'

Cakes, Plum. *Prep.* 1. (Good.) From butter, ½ *lb.*; dry flour, 3 *lbs.*; Lisbon sugar, 8 *oz.*; plums and currants, of each, ¾ *lb.*; and some pimento, finely powdered; to be 'wetted up' with 3 spoonfuls of yeast, and a Winchester pint of new milk (warmed); bake on a floured tin half an hour.

2. (Excellent.) From fresh butter, sifted sugar, flour, and currants, of each, 1 *lb.*; 18 eggs;

powdered spices, 2 *oz.* (viz. cloves, mace, cinnamon, nutmeg, and allspice); sliced almonds, 4 *oz.;* raisins (stoned and chopped), ½ *lb.;* and a large glass of brandy; bake in a hot oven. When sufficiently baked let the oven cool, and afterwards put in the cake and allow it to remain for several hours to dry (*Rundell*).

3. (Rich.) Take fresh butter and sugar, of each, 1 *lb.;* flour, 1½ *lbs.;* currants, 2 *lbs.;* a glass of brandy; sweetmeats and peels, 1 *lb.;* sweet almonds, 2 *oz.;* 10 eggs; allspice and cinnamon, of each, ¼ *oz.;* bake in a tin hoop in a hot oven for 3 hours, and put 12 sheets of paper under it to keep it from burning (*Mackenzie*).

Cakes, Port′ugal. *Prep.* From flour, powdered sugar, and fresh butter, of each, 1 *lb.;* 10 eggs; currants, ½ *lb.;* and a little white wine; bake in small tins only half filled.

Cake, Potato. 1 *lb.* of cold potatoes, ¼ *lb.* of flour or oatmeal, ½ gill of warm milk (with a ¼ *lb.* of yeast dissolved in it), a little salt and butter. Mash the potatoes, add the other ingredients, roll out the paste 1½ or 2 inches thick, place it in a greased tin, and bake it.

Cakes, Pound. *Prep.* 1. As plum cake; but using 1 *lb.* each of all the ingredients except the spices.

2. Using equal parts of sugar, flour, currants, and sultana raisins, and half that quantity each of butter, brandy, and candied peel, with spices as required.

Cakes, Queen. *Prep.* From about 1 *lb.* each of dried flour, sifted sugar, washed currants, and butter, with 8 eggs; the whole beaten for an hour, made into a batter, and baked in little tins, teacups, or saucers, only half filled. A little fine sugar is frequently sifted over them. Nutmeg, mace, and cinnamon are also sometimes added.

Cakes, Ratafi′a. *Prep.* Beat ½ *lb.* of sweet and 1 *oz.* of bitter almonds, in fine orange, rose, or ratafia water; mix ½ *lb.* of pounded sugar; add the whites of 4 eggs (well beaten); set it over a moderate fire in a preserving-pan; stir it one way until it is pretty hot, and when a little cool form it into small rolls, and cut it into thin cakes; shake some flour lightly on them, give each a light tap, put them on sugar-papers, sift a little sugar on them, and put them into a very slack oven.

Cakes, Rout. *Prep.* From flour, 2 *lbs.;* butter, sugar, and currants, of each, 1 *lb.;* 3 eggs; ½ pint of milk; 2 glasses of white wine; and 1 glass of brandy; drop them on a tin plate, and bake them.

Cakes, Savoy. *Prep.* From flour and sifted sugar, of each, 1 *lb.;* 10 eggs; and the rind of a lemon (grated); form a batter by degrees, put it into moulds, and bake in a slack oven.

Cake, Seed. *Prep.* 1. (Plain.) From flour, ¼ peck; sugar, ½ *lb.;* allspice, ¼ *oz.;* melted butter, ½ *lb.;* a little ginger; milk, ½ pint; yeast, ¼ pint; add seeds or currants, and bake an hour and a half.

2. (Good.) To the preceding add of butter and sugar, of each, ½ *lb.*, and wet it up with milk previously mixed with 6 eggs.

3. (Rich.) Take of flour, 1½ *lbs.;* butter and sugar, of each, 1 *lb.;* 8 eggs; 2 *oz.* of caraway seeds, 1 grated nutmeg, and its weight in cinnamon. Bake 2 hours in a quick oven.

4. (Scotch.) 9 eggs; sugar and butter, of each, ½ *lb.;* mix well together, then add a little cinnamon, nutmeg, and cloves; ¼ *oz.* of caraway seeds; ½ *lb.* of candied citron; ¼ *lb.* of candied orange peel; ½ *lb.* of blanched almonds (pounded fine); flour, 3 *lbs.;* and brandy, ¼ pint.

Cakes, Shrews′bury. *Prep.* From flour, 3 *lbs.;* sugar, 1 *lb.;* a little cinnamon and nutmeg; 3 eggs; a little rose water; and melted butter enough to make it into a dough.

Cakes, So′da. *Prep.* 1. From flour, 1 *lb.;* bicarbonate of soda, ¼ *oz.;* sugar and butter, of each, ½ *lb.;* make a paste with milk, and add candied orange, lemon or citron peel, or the fresh peels grated, q. s. to flavour.

2. To flour, 1 *lb.;* sugar and butter, of each, 2 *oz.;* candied peel, ½ *oz.;* sesquicarbonate of soda, 3 *dr.;* milk, q. s.

Obs. An equal weight of carbonate of magnesia, used instead of the soda, also makes good cakes. Both are suitable to delicate stomachs, especially in dyspepsia with acidity.

Cakes, Sponge. *Prep.* From 8 eggs; lump sugar, ¾ *lb.;* water, ¼ pint; the yellow peel of a lemon; mix as follows: Put the lemon peel into the water; when about to make the cake, put the sugar into a saucepan, pour the water and peel on it, and let it stand by the fire to get hot. Break the eggs into a deep earthen vessel that has been made quite hot; remove from the heat, whisk for a few minutes; make the sugar and water boil up, and pour it very gradually boiling-hot over the eggs; continue to whisk them briskly until they become thick and white; add the flour (quite warm), stir it lightly in, put the paste into tins lined with white paper, and bake them immediately in a moderately hot oven.

Cakes, Tea. *Syn.* Benton Cakes. *Prep.* 1. From flour, 1 *lb.;* butter, 4 *oz.;* and milk, q. s.; bake on a hot hearth or slow oven plate.

2. To the last add 2 tablespoonfuls of yeast.

Cakes, Tip′sy. *Prep.* Small sponge cakes steeped in brandy, and then covered with grated almonds and candied peel; or almonds (cut into spikes) are stuck in them. They are commonly piled on a dish, surrounded with a custard, and covered with preserves drained as dry as possible.

Cakes, Wigg. *Prep.* From ½ pint of warm milk; ¾ *lb.* of fine flour; and 2 or 3 spoonfuls of light yeast. Afterwards work in 4 *oz.* each of sugar and butter; make into cakes, or wings, with as little flour as possible, add a few caraway seeds, and bake them quickly.

Cakes. (In *medicine.*) Cakes have been used as a form of administering medicinal substances to children, but have not been extensively employed in this country for the purpose, unless by quacks and in domestic practice. In preparing them the active ingredients are added in such proportions to the common materials of a sweet cake that one or two, as the case may be, are sufficient for a dose. See Gingerbread, Worm-cakes, &c.

CAL′ABAR BEAN. *Syn.* Physostigmatis Faba. The seed of *Physostigma venenosum.* The plant is a native of Western Africa, where the bean is used as an ordeal poison. The bean itself is about the size of a large horse-bean, with a very firm, hard, brittle, shining coat of a

brownish-red, pale chocolate, or ash-grey colour. It has an irregular kidney shape, with flat surfaces and a rounded border, which is for the most part boldly curved, and there marked with a broad furrow, with the central raised raphé in the centre, and ending at one extremity in the micropyle. The kernel consists of two cotyledons. It yields its properties to alcohol, and imperfectly to water. E. M. Holmes has pointed out that the seed of *P. cylindrospermum* are sometimes sold for those of *P. venenosum.* Their distinguishing characters are given in the 'Pharm. Journ.,' 3rd Series, ix, 913. Calabar bean has been used in cases of strychnia poisoning and tetanus, as well as in epilepsy and St. Vitus's dance. The dose of the powdered bean, according to Royle, is 1 to 4 gr. Locally applied it produces contraction of the pupil.

Until the researches of Harnack and Witkowsky the Calabar bean was supposed to owe its activity, when internally administered, to the presence of a powerful alkaloid called *eserine* or *physostigmine.* These chemists, however, have lately succeeded in discovering in the bean, in addition to eserine, another very potent alkaloid, to which they have given the name *calabarine.*

Calabarine appears to exert a physiological action antagonistic to that of eserine; and since the commercial preparations of the drug consist, according to the above chemists, of mixtures of two alkaloids in varying proportions, the discordant effects frequently observed to follow the administration of any of the various preparations of the bean, admit of ready explanation. Whereever eserine predominated it appeared to suppress the effects of calabarine; on the other hand, if this latter preponderated, the paralysing effect on the spinal cord otherwise exercised by eserine would fail to be produced.

The necessity of having preparations of calabar free from calabarine, in cases where the drug is administered for tetanus, will be apparent when it is stated that calabarine itself induces the disease. M. Bohringer announces the discovery of another base in Calabar bean, *eseridine.* It closely resembles physostigmine, there being only a difference of a molecule of water in their formulæ.

We quote the following from 'New Remedies' for June, 1877:

"The well-known manufacturing chemist, E. Merk, in Darmstadt, has heretofore prepared and sold a substance which was supposed to be the only active principle of calabar, and which he called calabarine, but which was really eserine or physostigmine. He now accepts and confirms results of Harnack's and Witkowsky's researches, and has put both of the active principles upon the market labelled with their correct name, viz. '*Physostigmine*' (or eserine, being the same substance which he formerly sold as calabarine) and '*Calabarin,*' distinguished by the addition of Harnack's name (H rnack's 'Calabarine'). *The attention of physicians and pharmacists is particularly directed to the change of appellations.*"

Calabar bean is a powerful poison. The antidotes are: Diffusible stimulants; the hypodermic injection of the $\frac{1}{60}$th of a grain of sulphate of atropine, to be repeated if necessary at the end of two hours; and artificial respiration. See PHYSOSTIGMINE.

CALAMINE. See ZINC (Carbonate of).

CALANDRA GRANARIA, Linn. The Corn Weevil. This insect, of the Nat. Ord. COLEOPTERA, family *Curculionidæ,* and division *Rhyncophora,* does considerable damage to corn stored in granaries. The mischief caused by it is not apparent to the casual observer, but as the larva of the weevil concealed in the grain lives upon its substance, the valuable properties and weight of the corn are much diminished, and much loss is caused to farmers and corn merchants.

It attacks all kinds of corn, as well as malt. Foreign corn is frequently much infested with it, as it likes warm climates, and cannot live, or, at least does not propagate, in low temperatures. In the 'Introduction to Entomology' it is said that "sometimes this insect becomes so infinitely numerous that a sensible man engaged in the brewing trade once told me, speaking perhaps rather hyberbolically, that they collected and destroyed them by bushels." It is well known in France and Germany, and has been found to be very injurious in America. Dr Fitch reports that it has been imported with Italian grain, also that it is very destructive to seeds in the collections of the New York State Agricultural Society. Mr Cooke, the chief executive horticultural officer of California, states that it is a formidable pest in store-houses and mills in that country.

Life History. This weevil is dark red, about 1-8th of an inch in length, with six legs, and a very long beak or rostrum. It passes the winter in snug crannies and cracks in the floor and sides of granaries and warehouses, and comes out in the spring. Pairing takes place directly the weather is warm. The female gets into heaps of corn and deposits eggs in the grains, 1 egg in each grain. The larvæ, little white maggots, are hatched shortly, and eat the substance within the interior. The aperture made in the deposition of the egg is securely sealed up by some material supposed by Kirby, Curtis, and Taschenberg, to be excrementitious. The pupa stage is assumed and the weevils come from the grains when their contents have been pretty well cleared out, towards the close of the summer. Taschenberg holds that there are two broods in the season, but this has not been confirmed in this country. The weevils themselves may sometimes be found in the grains feeding upon their contents, as well as their larvæ.

Prevention. The best means of prevention are to have granaries and store-rooms well brushed down with stiff brushes or brooms, and washed with soft soap and hot water. After a bad attack this should be done 2 or 3 times over, and the doors and windows left open all day and night, as the weevils are very susceptible to cold.

Corn lying in suspected places should be moved and turned over and over frequently when in heaps, at the approach of warm weather, in order to disturb the females in egg-laying, and running it down through winnowing machines also prevents this.

Remedies. When it is discovered that corn is affected, or when beetles have been seen near corn heaps, drying with hot air, at a temperature of 130°

F. is efficacious, as the heat kills the weevils and their larvæ, but does not affect the quality of the grain or destroy its germinating power if the drying is conducted properly and the temperature gradually raised. Ventilation and the admission of cool air into places where corn is stored often have the effect of driving away the weevils. Long drain-pipes put into heaps of corn cause circulation of air which is unpleasant to the intruders. Traps may be then set for them by putting grain in the corners of the granaries. Corn injured by this weevil may be easily detected by its lightness. To the unskilful no difference can be noted; but the experienced farmer, corn merchant, or miller will detect that something is wrong by taking up a handful and weighing it in his hand ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CALCINA'TION. The operation of burning or roasting any solid body to expel its more volatile parts, or to oxidise it, as the conversion of chalk into lime by the expulsion of carbonic anhydride. The roasting of the ores in the first stage of the Welsh process of copper smelting and in the Silesian mode of extracting zinc is technically termed CALCINATION.

The method of conducting the process of calcination depends on the nature of the body operated on. Many substances, in delicate experiments, are calcined over a Bunsen burner or blowpipe in a platinum spoon or crucible; others, in iron vessels or earthenware crucibles, placed in a common furnace. When the action of the air proves injurious, as in the manufacture of charcoal, the process is performed in close vessels or chambers. In some cases the fuel is mixed with the articles, and they are both burnt together, as in the manufacture of lime, the roasting of ores, &c. The process of drying salts, or driving off their water, of crystallisation by heat, is also frequently called CALCINATION; thus we have calcined copperas alum, &c.

CALCI''NER. A reverberatory furnace used for the calcination of metallic ores, particularly those of COPPER and ZINC (which *see*).

CALCIUM. [Eng., L., Fr., Ger.] Ca. Atomic weight = 40. A metallic element belonging to the same group as strontium and barium, which metals it much resembles.

Source. Calcium, though never found free, occurs very widely in nature, and often in very large quantities, as the carbonate, sulphate, phosphate, fluoride, silicate, &c. (see the respective salts). Calcium salts occur in most natural waters, and in all plants and animals, especially in the leaves of plants and in the bones and teeth of animals.

Prep. 1. A mixture in the proportion of 2 molecules of calcium chloride to 1 molecule of strontium chloride, with a little sal-ammoniac, which mixture is more fusible than calcium chloride alone, is melted in a small porcelain crucible, and electrolysed, the positive pole being a carbon rod, and the negative a fine pianoforte wire, dipping just below the surface of the fused salt; small globules of calcium form on the end of the wire (*Matthiessen*).

2. Dry calcium iodide, 7 parts, is fused with 1 part of sodium in an iron crucible with an air-tight cover.

3. Calcium chloride, 3 parts, is fused with 4 parts of zinc and 1 of sodium. In this way an alloy of zinc and calcium is produced, which is then heated in a crucible made of gas carbon until the gas volatilises, when the fused calcium is found in the form of a button (*Caron*).

Calcium can be obtained pure only by method 1, and on a very small scale. By this method Frey succeeded in obtaining globules weighing from 2·4 to 4 grms.

Prop. According to Matthiessen, calcium is a yellow metal, harder than lead, tenacious and malleable, and with sp. gr. 1·578. Frey states that it has the colour of aluminium, and is very brittle. It oxidises readily in moist air, and decomposes water at the ordinary temperature with a violent evolution of hydrogen.

Tests. 1. A compound of calcium placed on a platinum wire, moistened with hydrochloric acid and held in the non-luminous gas-flame colours the latter red; the spectrum exhibits a large number of lines, of which a line in the green and another in the orange are the most characteristic. 2. Ammonium carbonate added to neutral solutions of calcium salts produces a white precipitate soluble in acids. 3. Ammonium oxalate added to neutral or alkaline solutions of calcium salts produces a white precipitate soluble in acids. 4. Sulphuric acid gives a white precipitate with fairly strong solutions of calcium salts. Calcium may be distinguished from barium by solutions of its salts, giving no precipitate with bichromate of potash. Strontium may be distinguished from calcium by the intense crimson coloration which it gives to the non-luminous flame.

Estim. To the solution of the calcium salt ammonium oxalate is added in moderate excess, and then solution of ammonia till the liquid smells of the latter. The solution is now allowed to stand for several hours, after which the white precipitate is carefully collected and washed with hot water, and then either converted by gentle heating into the carbonate and weighed as such, or strongly ignited so as to form the oxide (lime), which is then weighed. If it is weighed as the carbonate, the weight found must be multiplied by 0·56 in order to find the corresponding weight of the oxide.

Salts. Calcium forms one series of salts only, corresponding to the oxide CaO. They may all be prepared by dissolving this oxide or its hydrate, or calcium carbonate, in the suitable acids. They are colourless, and are soluble in water with the exception of the fluoride, carbonate, oxalate, and sulphate, which, however, except the sulphate, dissolve readily in acids.

Calcium, Acetate of. $Ca(C_2H_3O_2)_2$. *Prep.* By adding excess of purified chalk to acetic acid, filtering off the solution from the excess of chalk, evaporating it, and allowing it to crystallise.—*Uses.* As a diuretic.—*Dose*, 10 to 20 gr.

Calcium, Bromide of. $CaBr_2$. *Syn.* CALCII BROMIDUM, L.; BROMURE DE CALCIUM, Fr.; CALCIUMBROMID, Ger. *Prep.* By boiling a solution of ferrous bromide with a slight excess of lime, filtering, evaporating the solution and allowing it to crystallise, and then recrystallising the salt thus obtained. Very soluble in water.

Calcium, Carbonate of. $CaCO_3$. *Syn.* CALCII

CARBONAS, L.; CARBONATE DE CALCIUM, Fr.; CALCIUMCARBONAT, Ger. *Source.* This substance is widely distributed in nature, and occurs sometimes in vast quantities. Pure it is found as *calc-* or *Iceland-spar,* and *arragonite;* mixed with more or less silica, as *chalk, limestone, marble,* and *coral;* and in combination with magnesium carbonate as *dolomite* it forms whole mountain ranges. For further information, see CHALK.

Calcium, Chloride of. $CaCl_2$. *Syn.* CALCII CHLORIDUM, L.; CHLORURE DE CALCIUM, Fr.; CALCIUMCHLORID, Ger. *Prep.* (B. P.) "By neutralising hydrochloric acid with carbonate of calcium, adding a little solution of chlorinated lime and slaked lime to the solution, filtering and evaporating until it becomes solid, and finally drying the salt at about 204° C. (400° F.)."

Calcium chloride is formed as a waste product in many manufacturing processes, notably in the ammonia-soda process for making sodium carbonate, in the Weldon process for recovering the manganese from the still liquor produced in the manufacture of chlorine, and in the manufacture of ammonia from the ammonium chloride of the gas-works, and of carbonic acid from chalk or marble by the action of hydrochloric acid. Enormous quantities of calcium chloride are thus wasted yearly, as no method has yet been found of profitably obtaining the chlorine from it. Could this be done, it would be the death-blow to the Leblanc soda-process, which is already hard pressed by the rival ammonia-soda process.

Prop. Calcium chloride crystallises in large hexagonal prisms containing 6 molecules of water, which lose 4 molecules of water at 200° C. (400° F.), and at a higher temperature become anhydrous, and finally melt at a red heat. The crystals also melt at 290° C. (554° F.) in their own water of crystallisation; they deliquesce in air, forming an oily liquid once called *oleum calcis.* When they are dissolved in water a considerable lowering of temperature is produced; with a freezing mixture of 4 parts of crystallised calcium chloride and 3 parts of snow a temperature of − 48° C. (− 54° F.) can be attained. The anhydrous salt is hard, friable, and slightly translucent. 100 parts of water dissolve when cold 70 parts, when boiling 155 parts of the anhydrous salt; and solutions of 50, 200, and 325 parts of the anhydrous salt in 100 parts of water boil at 112°, 158°, and 180° C. (234°, 316°, and 356° F.), respectively.

Uses. It is not used on the large scale, but in the laboratory the anhydrous chloride is used for drying gases and depriving organic liquids of admixed water; for this purpose it is better that it should be merely dried, as it is then more porous than when fused. Solutions of calcium chloride are used as baths for heating stone-ware stills and other apparatus liable to be cracked on the sand-bath. As a *medicine* it has been used in scrofulous and glandular diseases.—*Dose,* 10 to 20 gr. See SOLUTIONS.

Calcium, Fluoride of. CaF_2. *Source.* It occurs native as FLUORSPAR (SPATH FLUOR, Fr.; FLUSS SPATH, Ger.) in Derbyshire—where it is known as BLUE JOHN,—in Saxony, and in many other countries, and is generally coloured by the presence of impurities.—*Prep.* As a white precipitate, by mixing solutions of calcium chloride and of a soluble metallic fluoride.

Calcium, Hypophosphite of. $Ca(H_2PO_2)_2$. *Syn.* CALCII HYPOPHOSPHIS, L. *Prep.* (B. P.) "By heating phosphorus and nearly twice its weight of hydrate of calcium with water until phosphoretted hydrogen gas ceases to be evolved, then filtering the liquid, separating uncombined lime with carbonic acid gas, and evaporating the remaining solution until the salt separates in a crystalline condition."—*Prop.* A white crystalline salt, with a pearly lustre and a bitter nauseous taste, soluble in 8 parts of cold water, but insoluble in alcohol.—*Uses.* Given in cases of nervous and general debility, also said to be useful in phthisis.

Calcium, Iodide of. CaI_2. *Syn.* CALCII IODIDUM, L.; IODURE DE CALCIUM, Fr.; CALCIUMIODID, Ger. *Prep.* Like the bromide (which *see*), using ferrous iodide instead of the bromide.—*Prop.* A white deliquescent salt with a bitter taste, easily soluble in water.—*Use.* It has been used in scrofulous affections, internally, in doses ranging from $\frac{1}{8}$ to 2 gr., thrice daily, and externally in ointments containing 2 dr. or less to the oz.

Calcium, Lactophosphate of. A flavoured solution of precipitated calcium phosphate in lactic acid.

Calcium, Oxides of. There are two oxides of calcium, the monoxide, or lime, CaO; and the peroxide, CaO_2.

1. *Calcium Monoxide.* CaO. For this substance and its hydrate see LIME.

2. *Calcium Peroxide.* CaO_2. Mr Mond has lately taken out a patent for the manufacture of this substance, which he proposes to use in bleaching. Blocks of barium carbonate, pitch, and sawdust or carbon are introduced into the top of a cupola furnace, where they are heated to about 1200° C., and the barium carbonate is transformed into barium oxide and the carbonaceous materials burnt out. The descending mass is cooled by meeting a current of air, and at 500° C. the barium oxide absorbs oxygen from the air, and forms the peroxide. This, when quite cold, is decomposed by carbonic acid and water under pressure, yielding barium carbonate, which is again used as above, and hydrogen peroxide, which is mixed with milk of lime, whereby hydrated calcium peroxide ($CaO_2 + 8H_2O$) is precipitated. This contains 7·4% available oxygen (equivalent to 32·8% available chlorine), and Mr Mond proposes to make it as a source of hydrogen peroxide to be used for bleaching. The peroxide of barium itself could not be manufactured at a low enough price to render its use on the large scale possible.

Calcium, Phosphates of. These are three in number:

1. *Acid Phosphate.* $Ca(H_2PO_4)_2$. *Syn.* SUPERPHOSPHATE OF LIME, SOLUBLE ACID PHOSPHATE. *Prep.* By treating bone-ash with 2-3rds of its weight of sulphuric acid; a solution of the acid phosphate is thus obtained, together with insoluble calcium sulphate. The mixture of these salts obtained by evaporating the solution is called *superphosphate of lime,* and is extensively used as a manure for turnips and other crops.

2. *Bibasic Phosphate.* $CaHPO_4 + 2H_2O$. *Prep.*

608 grms. crystallised calcium chloride are dissolved in 1 litre of distilled water, and a solution of 1000 grms. sodium phosphate in 10 litres of water gradually added. The precipitate is allowed to deposit, washed 5 or 6 times with 10 litres of water each time, drained on a cloth, and allowed to dry in the air.

3. *Phosphate.* Ca_3PO_4. *Syn.* CALCII PHOSPHAS, L. *Source.* It occurs naturally as *apatite, phosphorite, coprolites,* &c., and forms 80% of burnt bones. *Prep.* (B. P.) Digest 4 oz. of bone-ash in 6 fl. oz. of hydrochloric acid of sp. gr. 1·16, diluted with a pint of water, until it is dissolved, boil for a few minutes, add a pint of water and afterwards solution of ammonia of sp. gr. 0·96 until the liquid acquires an alkaline reaction; about 12 fl. oz. will be required. Collect the precipitate on a calico filter, wash it with boiling distilled water till the wash water no longer gives a precipitate with a solution of silver nitrate acid and nitric acid, and dry it at 100° C. (212° F.).—*Prop.* A light white amorphous powder, insoluble in water, but soluble without effervescence in dilute nitric acid.

Calcium, Phosphide of. *Prep.* By passing the vapour of phosphorus over red-hot lime; it is thus obtained mixed with calcium phosphate as a brown mass. It is decomposed by water with evolution of phosphuretted hydrogen.

Calcium, Sulphate of. $CaSO_4 + 2H_2O$. *Syn.* CALCII SULPHAS, L.; SULPHATE DE CALCIUM, Fr.; CALCIUMSULFAT, Ger. *Source.* It occurs native as *gypsum, selenite,* and *alabaster;* in the anhydrous condition it occurs as *anhydrite,* or when made artificially by heating gypsum it is termed *plaster of Paris.*—*Prep.* 1. As a white insoluble precipitate by adding sulphuric acid to a strong solution of calcium chloride. 2. By heating gypsum (B. P.).—*Prop.* A white powder insoluble in alcohol, soluble in 500 parts of water. See GYPSUM, SELENITE.—*Uses.* Valuable for making casts; also plaster of Paris splints and jackets, &c.

Calcium, Sulphides of. *Monosulphide.* CaS. *Syn.* PROTOSULPHIDE OF C. *Prep.* By calcining 25 parts dried gypsum with 4 parts lamp-black or powdered charcoal in a covered crucible. It forms a white mass, insoluble in water; after exposure to light it is luminous in the dark, and is therefore used as a luminous paint on match-boxes.

Polysulphides. A number of higher sulphides of calcium are formed by boiling milk of lime with sulphur. Little is known about them.

Uses. See MANGE.

Sulphurated Lime. *Syn.* SULPHIDE OF CALCIUM; CALX SULPHURATA, CALCII SULPHURIDUM, L. *Prep.* (B. P.) Mix thoroughly 7 oz. calcium sulphate with 1 oz. wood charcoal, both in fine powder. Heat the mixture to redness in an earthen crucible until the black colour has disappeared. Cool, and at once place the whitish residue in a stoppered bottle.—*Prop.* A nearly white powder with a smell resembling that of sulphuretted hydrogen. It contains upwards of 50% of calcium sulphide (CaS), and dissolves in hydrochloric acid with evolution of sulphuretted hydrogen.

Use. It is acrid, caustic, and diaphoretic.—*Dose,* 1-10th to 1 gr. Sulphide of calcium has been used as a depilatory by applying it made into a paste with water, and washing it off in about $\frac{1}{4}$ of an hour. Made into an embrocation, it has been strongly recommended in gout, scabies, &c. Useful as a depressant and alterative; disperses boils.

CALCULA'TIONS (Useful). 1. To find the value of a dozen articles. Take the price in pence as shillings, and if there are any farthings in the price add 3*d.* for each. Thus 2*s.* 8*d.*, or 32*d.* per yard is £1 12*s.* per dozen.

2. Find the value of 100 articles. For every farthing take as many pence and twice as many shillings. Thus $1\frac{1}{4}d.$ each is—5*d.*, and 10*s.* = 10*s.* 5*d.* per 100.

3. To find the value of a pound at any price per oz. Take the price in farthings as shillings, and divide by 3. Thus, $5\frac{1}{4}d.$ per oz. is 21 farthings; taken as shillings, 21 ÷ 3 = 7*s.* per lb.

4. To find the value of an oz. at any price per lb. Take the shillings as farthings and multiply by 3. Thus, at 6*s.*—6 × 3 = 18 farthings, or $4\frac{1}{2}d.$ per oz.

Obs. By reversing Nos. 1 and 2, the price of a single article or lb. may be found from the price per dozen or 100. For several other calculations, useful in domestic economy, chemistry, &c., see BREWING, DECIMALS, EQUIVALENTS, MEASURES, PERCENTAGE, WEIGHTS.

CAL'CULUS. *Syn.* STONE. In *medicine,* a hard concretion formed within the animal body by the deposition of matters which usually remain in solution. The concretions most commonly found are those formed in the kidneys or bladder, and termed urinary calculi, and those formed in the gall-bladder or biliary ducts, which are called biliary calculi. Urinary calculi are in most cases composed of substances which are constituents of healthy urine, such as uric acid, urate of ammonia, and the phosphates of lime, and magnesia; they are, however, sometimes composed of substances which are met with in unhealthy urine, such as oxalate of lime, cystine, &c.

Biliary calculi, or gall-stones, usually contain from 50 % to 80 % of cholesterin, a crystallisable fatty body, constituting a never failing ingredient in healthy bile, the rest of the concretion being made up of biliary resin and colouring matter, with a small quantity of inorganic salts.

Both of these give rise to very painful symptoms, and may even threaten life. See CHOLESTERIN.

CALEFACIENTS. Applications that excite warmth.

CAL'ENDAR. *Syn.* CALENDA'RIUM, L.; CALEN'DRIER, Fr. A table of all the days of the year, arranged in the order of days and weeks, to which are generally added certain astronomical indications and dates of great civil and religious events. The most remarkable calendars are the Hebrew calendar, the calendar of the Greeks, the Roman, or Julian calendar, the Gregorian calendar (now adopted by all Christian peoples except the Greeks and Russians), and the French Republican calendar, which, having remained in force about thirteen years, was abolished by Napoleon I. on the 1st of January, 1806.

Calendar, Perpet'ual. A table which furnishes

the general indications necessary to construct a calendar for any year, and to resolve, without error, many difficulties connected with the verification of dates.

CAL'ENDERING. The process of finishing by pressure the surface of linen or cotton goods. It is usually performed by passing the fabric between cylinders pressed together with great force. It is necessary that one of the cylinders, at least, shall be of a material combining considerable hardness with a slight degree of elasticity; for this purpose a paper cylinder is used. It is made by forcibly compressing a number of circular discs of thick pasteboard, each with a square hole in the centre, upon an iron axis, so as to form a solid cylinder, which is turned perfectly smooth and true in a lathe. The paper cylinder usually works against a hollow roller of copper or iron, heated by steam or metallic heaters. Before the final rolling in the calendering machine the fabric is lightly smoothed by passing over warm cylinders. Cotton goods are starched, and a fictitious appearance of stoutness is sometimes given to them by employing starch thickened with plaster of Paris, porcelain clay, or a mixture of these. Watering is a beautiful effect, produced by means of a hot cylinder with a pattern raised upon it. Glazing is produced by combined rubbing and pressure, the rollers being made to move with unequal velocities, so that one side of the fabric is rubbed as well as pressed by the roller whose surface moves with the greater speed. A copper cylinder is preferred for glazing, and is made so hot that if the machine stops it burns the goods. The old method of glazing consisted in burnishing the surface of the fabric with a polished flint.

CALENDULA. *Syn.* MARIGOLD. The leaves and flowers of *Calendula officinalis.* A tincture, 1 in 10 of rectified spirit, is used as an application to wounds and sore places, to promote healing. The tincture should be diluted with 10 parts water.

CAL'ICO. See COTTON.

Cal'ico Printing. The art of producing figured patterns upon calico by means of dyes and mordants topically applied by wooden blocks, copper-plates, or engraved cylinders. The goods are either directly printed in colour, or receive their patterns by being run through a colouring matter or mordant, when the dye is only produced upon that portion of the ground previously prepared for it. Of late this system of dyeing has been extended to silk and woollens.

The mordants are thickened with some glutinous substance, as flour, starch, or gum, to render them adhesive and to prevent their spreading.

The following are the principal styles of calico-printing, each requiring a different method of manipulation:

In the madder, fast colour, or chintz style, the mordants are applied to the white cloth, and the colours are brought out in the dye-bath. This is the method commonly followed for 'permanent prints.'

In the padding or plaquage style, the whole cloth is passed through a bath of some particular mordant, and different mordants are afterwards printed on it before submitting it to the dye-bath. By this means the colour of the ground and pattern is varied, Like the last, it is much used for gown pieces, &c.

In the reserve or resist-paste style, white or coloured figures are produced by covering those parts with a composition which resists the general dye afterwards applied to form the ground of the pattern. In this style the dye-bath is indigo, or some other substantive colour.

The discharge, or rongeant style, is the reverse of the preceding; it exhibits bright figures on a dark ground, which are produced by printing with acidulous discharge mordants after the cloth has been passed through the colouring bath.

Steam-colour printing consists in printing the calico with a mixture of dye-extracts and mordants, and afterwards exposing it to the action of steam.

Spirit-colour printing is a method by which brilliant colours are produced by a mixture of dye-extracts and solution of tin, called by the dyers 'spirits of tin.'

Pigment printing consists in applying such colours as ultramarine, magenta, or aniline purple, to the cloth, and fixing them by such as casein, albumen, or solution of india rubber. This style of printing has been developed to a great extent since the introduction of the splendid mauves and purples obtained from aniline.

For further information on this subject the reader is referred to Ure's 'Dictionary of Arts, Manufactures and Mines,' Calvert's 'Dyeing and Calico Printing,' edited by Stenhouse and Groves, Wagner's 'Clinical Technology,' and Crooke's 'Practical Handbook of Dyeing and Printing,' where he will find the several processes of calico printing fully treated on, and most ably and accurately described. To enter largely into the subject in this work might interest the reader, but would be of no practical value; as calico printing is an art only practised on a large scale, and by men who obtain their whole knowledge of it in the laboratories and printing rooms of the factories.

CAL'OMEL. See MERCURY (Chlorides of).

CALOTRO'PIS GIGANTEA.
CALOTRO'PIS PROCERA. } (Ind. Ph.)

Syn. MUDAR. *Habitat.* One or other of these species everywhere in India.—*Officinal Part.* The root-bark, dried (*Calotropis cortex*). Small, flat, arched pieces, brownish externally, yellowish grey internally; smell peculiar; taste mucilaginous, nauseous, and acrid. Its activity appears to reside in a peculiar extractive matter named *mudarine.*—*Prop.* Alterative tonic; diaphoretic, and in large doses, emetic.—*Therapeutic Uses.* In leprosy, constitutional syphilis, mercurial cachexia, syphilitic and idiopathic ulcerations, in dysentery, diarrhœa, and chronic rheumatism, it has been used with alleged benefit.

Powder of Mudar. (*Pulvis Calotropis.*) Take of the roots of mudar, collected in the months of April and May from sandy soils, a sufficiency; carefully remove, by washing, all particles of sand and dirt, and dry in the open air, without exposure to the sun, until the milky juice contained in it becomes so far inspissated that it ceases to flow on incisions being made in it. The bark is then

to be carefully removed, dried, and reduced to powder and preserved in well-corked bottles.—*Dose.* As an alterative tonic, 3 gr., gradually increased to 10 gr. or more, thrice daily. As an emetic, from ½ to 1 dr.

CAL'OTYPE. See PHOTOGRAPHY.

CALUM'BA. *Syn.* CALUMBÆ RADIX, B. P. CALUM'BA-ROOT; KALUMB, Hind. The root of a plant of Eastern Africa, extensively used in *medicine* as a stomachic and mild tonic.—*Dose,* 10 to 20 gr. three or four times a day. The botanical name of this plant is *Jateorhiza calumba,* or *Cocculus palmatus.* See CALUMBINE (*below*); also INFUSIONS and TINCTURES.

CALUM'BA WOOD. This wood, which is used as a tonic by the Cingalese, is not the produce of the true calumba plant, but of *Menispermum fenestratum.* It contains the alkaloid BERBERINE (which *see*).

CALUM'BINE. *Syn.* CALOM'BINE, CALUM'BINA. A bitter substance discovered by Wittstock in calumba root.

Prep. 1. Digest calumba root (in coarse powder) in water acidulated with acetic acid; express, filter, boil to one half, again filter, add carbonate of calcium, in slight excess, and evaporate to dryness in a water-bath; reduce the residuum to powder, and digest it in boiling alcohol; the latter will deposit crystals of CALUMBINE on cooling.

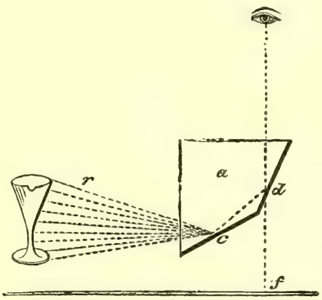
2. (*Wittstock.*) Evaporate tincture of calumba root (made with rectified spirit) to dryness; dissolve the residuum in water, and agitate the solution with an equal bulk of ether; after repose for a short time, decant the ethereal portion, distil off most of the ether, and set the liquid aside to crystallise.

Prop., &c. Impure calumbine occurs as a yellow-brown mass; when pure, it forms rhombic prismatic crystals or delicate white needles; it is only slightly soluble in alcohol, ether, and water; 40 parts of boiling rectified spirit take up only 1 part of calumbine. Its best solvent is acetic acid; it is also soluble in acidulated and alkalised water. Neither nut-galls nor metallic salts affect its solution. Concentrated sulphuric acid dissolves it, and assumes first a yellow, and then a red colour. Its properties indicate that weak vinegar or sour wine would be the best menstruum for extracting the medicinal virtues of calumba root.—*Dose,* 1 to 3 gr. twice a day as a tonic and stomachic, in dyspepsia, debilitated stomach, bilious vomiting, &c.; and in the later periods of dysentery and diarrhœa.

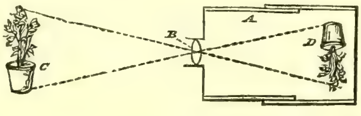
CALX. This term was formerly applied to the residuum of the combustion of any substance; or to any substance which had been exposed to a strong heat. See CALCINATION, LIME, &c.

CAMBOGE'. See GAMBOGE.

CAM'ERA LU'CIDA. [L. and Eng.] When a ray of light (*r*) falls upon a quadrangular glass prism (*a*), it is bent by two reflections (at *c* and *d*), and thrown upwards, where it may be received by the eye, to which it will appear described on the table or sheet of paper (*f*) placed to receive it. The point of a pencil used to trace any object on the paper can also be seen, and by its means the picture can be easily copied. When the prism is mounted on a stand, and a thin brass plate with a small hole through it for the eye-piece adjusted thereto, it forms the CAMERA LUCIDA of the opticians. The image may be magnified or lessened by placing a lens so as either to intercept the rays before they strike the prism, or before they reach the eye.



CAM'ERA OBSCU"RA [L. and Eng.] An optical instrument for producing upon a screen the image of a field of view more or less extensive. It was invented by Baptista Porta in the 16th century. The principles and construction of the camera obscura may be thus described: A convex lens (*B*) is placed in a hole admitting the light into a darkened box or chamber (*A*), which, falling on a white ground (*D*), produces an inverted picture of every object within its range. The image thus formed may be restored to its natural position, by allowing the rays of light to pass through two lenses instead of one, or by receiving the rays on a mirror placed at an angle of 45°, when the image will be thrown on the floor in its original position. The picture may be viewed through an oblong aperture cut in the box, or the experiment may be performed in a darkened room by placing the lens in a hole in the shutter and allowing the image to fall on the wall, or on a sheet of white paper stretched to receive it.



In the simplest form, when intended for taking views or portraits, the image is thrown upon a mirror placed at an angle of 45°, and resting on the bottom of the box, by which means it is thrown upwards against a plate of glass, also placed at a similar angle. On this is laid a piece of semi-transparent tracing-paper, on which the object is distinctly seen painted, and may be traced out with a pencil. Achromatic glasses are also employed.

Camera, Photographic. See PHOTOGRAPHY.

CAM'PHINE. The name given by the trade to rectified oil of turpentine when sold for burning in lamps, in order that purchasers may not be aware of the inflammable character of the liquid. Since the introduction of the hydrocarbon oils from coal, shale, and petroleum, camphine has been little used for burning. To rectify the

turpentine, it is passed in vapour through a solution of caustic potash, soda, or lime; or through sulphuric acid.

CAM′PHOR. $C_{10}H_{16}O$. *Syn.* CAM′PHIRE, LAU′REL CAM′PHOR; CAMPHO′RA, B. P. A crystalline stearoptene found in many plants; though only obtained in large quantities from two, namely *Cinnamomum camphora* and *Dryobalanops aromatica.* The first, commonly known as the laurel camphor tree of China and Japan, yields the camphor of commerce; the latter, the Sumatra or Borneo camphor, and the peculiar fluid known as liquid camphor.

It is found that several of the essential oils, by carefully distilling off about 1-3rd their volume, yield a species of camphor, or stearoptene. By collecting this, and redistilling the remainder of the oil 2 or 3 times, a further quantity of camphor may be obtained. Oil of rosemary, treated in this way, yields about 10% of camphor; oil of sweet marjoram the same; oil of sage yields 13%; oil of lavender, 25%. By keeping the oils loosely corked and in a cool place, they produce a larger portion of this camphor. Aniseed camphor is the congealable portion of oil of aniseed, separated from the liquid oil, which it resembles in odour and flavour. Menthol and thymol are likewise camphors obtained respectively from oils of peppermint and ajowan.

Camphor, Am′ber. See PYRETINE (Crystallised).

Camphor, Commer′cial (Crude). The produce of the laurel camphor tree, brought to Europe chiefly from China and the Island of Formosa, in the form of greyish grains, aggregated into crumbling cakes.—*Prep.* The Chinese and Japanese extract the camphor by cutting the wood into small pieces, and boiling it with water in iron vessels, which are covered with large earthen capitals or domes, lined with rice-straw. As the water boils, the camphor is volatilised along with the steam, and condenses on the straw.

Cam′phor, Commercial (Refined). *Syn.* WHITE CAMPHOR; CAMPHO′RA; B. P. *Prep.* 100 parts of crude camphor are mixed with 2 parts each of quicklime and animal charcoal, both in powder, and the mixture if placed in a thin, globular, glass vessel, sunk in a sand-bath. The heat is then cautiously applied, and the vessel gradually and carefully raised out of the sand as the sublimation goes on. When the process is complete, the subliming vessel is removed and allowed to cool.

Obs. The whole process of refining camphor requires great care and experience to ensure its success. If conducted too slowly, or at a heat under 375° F., the product is found to be flaky, and consequently unsaleable, without remelting or subliming. An improvement on the common method is simply to sublime the above mixture in any convenient vessel furnished with a large and well-cooled receiver, and to remelt the product in close vessels under pressure, and to cool the liquid mass as rapidly as possible.

Prop., &c. A colourless translucent crystalline solid, very volatile at common temperatures; freely soluble in alcohol, ether, bisulphide of carbon, benzol, oils, and acetic acid, and sufficiently so in water (about 1¼ gr. to 1 oz.), to impart its characteristic smell and taste; 100 parts of alcohol (sp. gr. ·806) dissolve 120 parts of camphor; concentrated acetic acid dissolves twice its weight of camphor; average sp. gr. ·990. It fuses at 347°, boils at 400° F., and when set fire to, burns with a bright flame. It evaporates slowly at ordinary temperatures and crystallises on the inside of bottles. While floating on water, in small shreds, it undergoes a curious rotatory movement.

Uses, &c. Camphor is antiseptic, sedative, narcotic, anodyne, diaphoretic, and anaphrodisiac.—*Dose,* 2 to 10 gr. in the form of a pill or bolus, or made into an emulsion with yelk of egg, mucilage, or almonds. In overdoses it is poisonous. The best antidote is opium or wine, preceded by an emetic. It is also used externally in ointments, liniments, and embrocations.

Camphor is frequently put into wardrobes and clothes-trunks, to keep away insects; it is used to make the white stars and fire of the pyrotechnist; and by the varnish-maker to increase the solubility of copal and other gums. Mixed with six times its weight of clay, and distilled, it suffers decomposition, and yields a yellow, aromatic, volatile oil, smelling strongly of thyme and rosemary, which is much used by the wholesale druggists and perfumers to adulterate some of the more costly essential oils, and by the fancy soap makers to scent their soaps.

Camphor may be beaten in a mortar for some time, without being reduced to powder, but if it be first broken with the pestle, and then sprinkled with a few drops of rectified spirit of wine, it may be readily pulverised. By adding water to an alcoholic or ethereal solution of camphor, this drug is precipitated under the form of an impalpable powder of exquisite whiteness. Rubbed in a warm mortar with an equal weight of chloral hydrate, the two form a liquid.

Tests. Pure camphor is entirely soluble in rectified spirit, oils, and strong acetic acid; a fragment placed on a heated spoon or in a warm situation will wholly disappear, and the evolved fumes will be highly fragrant (camphoraceous), and be free from an acid or terebinthinate odour. In an alcoholic solution of natural camphor ammonia gives but a slight precipitate, which is dissolved on shaking the mixture; a similar solution of artificial camphor under the like treatment gives a flocculent precipitate, which remains undissolved. See CAMPHOR, FACTITIOUS (*below*).

Camphor, Facti″tious. *Syn.* HYDROCHLORATE OF TUR′PENTINE, HYDROCHLORATE OF CAMPHENE, ARTIFICIAL CAMPHOR. Prepared by passing dry hydrochloric acid gas into pure oil of turpentine, cooled by a freezing mixture or pounded ice. After a time a white crystalline mass is formed, which must be drained, and dried by pressure between folds of bibulous paper. It may be purified by solution in alcohol.

Prop., &c. It has a camphoraceous taste and odour; burns with a greenish, sooty flame, and when blown out evolves a terebinthinate odour; heated a little above the boiling-point of water slight fumes of hydrochloric acid gas are perceptible.

Camphor, Hydrochlo″rate of. *Syn.* MU″RIATE OF CAMPHOR; CAMPHO′RÆ HYDROCHLO″ROS, L.

By passing hydrochloric acid gas over camphor, in small fragments, until it ceases to be absorbed.

Camphor, Liq′uid. *Syn.* CAMPHOR OIL; O′LEUM CAMPHO′RÆ. A volatile oil, varying in colour from water white to dark amber, is obtained in Japan, as a by-product during the manufacture of camphor. According to P. MacEwan, its nature is very variable, having sp. gr. from ·926 to ·974. It is much used in this country by soapmakers as a perfume. Large quantities are imported into the United States, where it is stated to be principally used as an adulterant of essential oils. In Germany the oil is subjected to cold for the purpose of extracting the camphor it deposits, the oil is then distilled and used for varnish making. Applied locally, it has been found beneficial as a liniment for rheumatism and painful parts.

Camphor, Monobromated. $C_{10}H_{15}OBr$. Coarsely powdered camphor is introduced into a flask of about 10 times the capacity of the amount it is intended to prepare. A fine stream of bromine is then allowed to fall upon the powder with continual agitation; the addition of bromine ceases when the camphor is liquefied. A large long abductor tube is then fitted to the flask, and the other end plunged into an alkaline solution, which will absorb the vapour that would otherwise incommode the operator. The flask is placed in a water-bath that is raised to ebullition, when the reaction soon commences. This is at first rather active, there being an abundant evolution of hydrobromic gas, and some vapour of bromine and undecomposed camphor. The liquid, which is at first dark brown in colour, acquires an amber colour and the evolution of gas suddenly slackens. The operation should be carried out at a temperature between 80° and 90° C. The amber-coloured liquid that remains in the flask solidifies upon cooling, and appears then as a slightly citrine-coloured friable mass. It is purified by treating it several times with boiling 90% to 95% alcohol, filtering the liquor and leaving it to crystallise. The crystals are to be dried in the air upon unsized paper.

Dr Bourneville advises monobromated camphor to be administered either in the form of pills, made up with conserve of roses, or of a mixture rubbed up with mucilage of gum-arabic and syrup. He gives it in doses varying from 12 to 30 centigrms. daily. Where it cannot be taken by the mouth he injects the following solution subcutaneously: Monobromated camphor, 3 gr.; alcohol, 35 gr.; glycerin, 22 gr. It acts as a powerful antispasmodic.

Camphor, Nitrate of. *Syn.* CAMPHOR OIL; O′LEUM CAMPHO′RÆ FACTI′′TIUM, L. Prepared by dissolving camphor in nitric acid, in the cold.

Camphor, Sul′phite of. From camphor and sulphurous acid gas, as hydrochlorate of camphor.

Camphor, Suma′tra. *Syn.* BOR′NEO CAMPHOR, HARD C., DRAGON'S BRAIN PERFUME. Obtained from *Dryobalanops aromatica,* being found in natural fissures or crevices of the wood. It resembles ordinary camphor in most properties, but its odour is not of so diffusible a nature. This kind is not seen in European commerce.

CAMPHOR CAKES. See BALLS (Camphor).

CAMPHOR′IC ACID. $H_2C_{10}H_{14}O_4$. *Syn.* ACIDUM CAMPHOR′ICUM, L. *Prep.* From camphor, 1 part; and nitric acid (sp. gr. 1·33), 4 parts; distilled together in a glass retort, with a gradually increasing heat, until vapours cease to be evolved; the camphor that has volatilised is then added to that in the retort, along with 4 or 5 parts more of nitric acid, and the process repeated again and again, until 20 parts of acid have been consumed, when crude camphoric acid crystallises out of the remaining liquor on cooling. The crystals are purified by washing with cold distilled water, solution in boiling water, and evaporating the solution until a pellicle forms; crystals of pure camphoric acid are formed as the liquid cools.

Prop., &c. Small, colourless, lamellar or acicular crystals; acid; bitter; fusible at 158° F. (70° C.); sparingly soluble in water; soluble in alcohol; alcoholic solution not precipitated by water, which distinguishes camphoric acid from benzoic acid. Its salts are called CAMPHORATES. The soluble camphorates may be made by digesting the carbonate or hydrate of the metal in a hot solution of the acid, and the insoluble camphorates by double decomposition. By distillation, camphoric acid yields a colourless, crystalline, neutral substance, which has been shown to be camphoric anhydride.

CAM′WOOD. This dye-stuff resembles Brazil wood in its properties, and is used in a similar manner.

CAN′ADA BALSAM. *Syn.* BAL′SAMUM CANADEN′SE, TEREBINTH′INA CANADEN′SIS, L. A thick, viscid oleo-resin obtained from the *Abies balsamea,* Lindley, a tree of common growth in Canada and the State of Maine. It is much employed as a medium for mounting microscopic objects. When pure it is perfectly transparent, has an agreeable odour (not terebinthinate), and is wholly soluble in rectified oil of turpentine, with which it forms a beautiful glassy and colourless varnish, much used for preparing a semi-transparent copying paper.

In order to prepare Canada balsam for mounting microscopic objects it is convenient to bake it for some time in thin layers on an earthenware plate; in order to drive off certain fluid constituents which harden extremely slowly; when the balsam is quite dry and brittle, clean picked fragments may be dissolved in benzol or chloroform, and a very manageable mounting medium is obtained, which will set hard very quickly. See MICROSCOPE.

A mixture of 3 parts of Canada balsam and one of wax, if added to pill masses, is said to have the effect of binding together the component parts of the mass, and of keeping the pills made from it soft and in good shape.

Canada Balsam, Facti′′tious. *Syn.* BALSAMUM CANADENSE FACTI′′TIUM, L. *Prep.* 1. Yellow resin, 3 lbs.; oil of turpentine, 1 gall.; dissolve, and add essence of lemon, 2 dr.; oil of rosemary, 1¼ dr.

2. To the last add of nut oil, 1 pint. Both are sold in the shops for Canada balsam.

CANARINE. A yellow dye which, besides being said to be fast, is the only one which admits of being fixed direct on cotton without any mordant. It is prepared by acting upon potas-

sium sulphocyanide with potassium chlorate and hydrochloric acid.

One part of potassium sulphocyanide is dissolved in 2 parts of water, and a mixture consisting of 0·1 part potassium chlorate and 1 part hydrochloric acid added. Within a very few minutes the whole becomes spontaneously hot, gases are evolved, and a precipitate formed. When the action has nearly ceased, the mixture is cooled by placing the vessel containing it in cold water, and a further mixture consisting of 0·4 part of potassium chlorate and 1 part hydrochloric acid gradually added. The whole is then filtered, and the orange-coloured precipitate washed with water. This is crude canarine. Care must be taken that during the entire process the temperature does not sink below 80° C., since in this case a considerable quantity of persulphocyanogen would be formed, which, though it has a dyeing power, is not at all equal to canarine.

Pure canarine is formed from crude canarine by heating the latter with 1 part caustic potash and 20 parts of water, and heating till a complete solution takes place. The solution is filtered, cooled to 40° C., and the potassium compound of canarine precipitated by the addition of 20 parts of alcohol. The whole is allowed to stand 12 hours, and the precipitate washed with alcohol. This, treated with hydrochloric acid, washed and dried at 100° C., yields pure canarine. Pure canarine is a reddish-brown lustrous powder, soluble in caustic alkalies.

CAN′DIES. See CANDYING.

CAN′DLES. Candle-making, once a rude and noisome trade, has, since the researches of Chevreul and Branconnot into the nature of the fats, developed into one of the most important branches of scientific industry, the progressive improvements in which, accompanied by a corresponding cheapening and immensely increased efficiency in one of our chief means of artificial illumination, have added greatly to the comfort and enjoyment of every civilised community. Candles are either dipped, moulded, or rolled. The cheaper sorts of tallow candles are formed by the first process, and wax candles by the last; all the other kinds are moulded. The moulds are tubes of pewter, well polished on the inside, eight or more being fitted into a frame, the upper part of which forms a trough to receive the melted candle material. When in the moulds the candles are inverted; in other words, the bottom of each mould corresponds to the top of the candle. The wick passes through a small hole at the lower extremity of the tube, and is held in the axis by a little bar placed across the top. At the factories of Price's Patent Candle Company the frames of moulds are ranged close together in long benches, are filled with hot candle material from cars running along little railways above them. When quite cold the candles are withdrawn. The plan of pulling them out one by one with the aid of a bodkin has been superseded at the factories above mentioned by the ingenious device of blowing them out with compressed air.

The wicks of ordinary tallow candles are made of the rovings of Turkey skein-cotton, 4 or more of which, according to the intended thickness of the wick, are wound on a reel, from which they are again run off, and cut into the proper lengths. Of late years the wicks of the best candles have been made in such a way that they do not require snuffing. This object is effected by causing the wick to bend over, and its end to fall outside the flame, where it is exposed to the oxygen of the air. This bending over is variously brought about. 1. By twisting the wick with one strand shorter than the rest, which, being slightly stretched during the moulding of the candle, contracts again and bends the wick when the fat melts. 2. By plaiting the cotton into a flat wick, which naturally takes the required curve. Such a wick is generally dipped in a solution of borax, which preserves it from being acted upon by the flame except at its extreme point at the edge of the flame. A very fine wire is sometimes included in the plaited wick. 3. In Palmer's patent two-wicked candles, which were formerly much used in lamps, the wicks are saturated with subnitrate of bismuth ground up with oil; they are then twisted tightly round a wire, which is withdrawn after the candle is moulded. In burning, the ends gradually untwist and stand out of the flame on either side. Other devices are said to be employed.

The wicks of candles should be free from knots and inequalities, as well as from adhering particles of cotton, the presence of all of which are the cause of the 'guttering' one frequently sees in a burning candle. The finer the thread of which the wick is composed the more complete will be the combustion of the melted fatty material. Unless the above precautions are attended to in selecting the wick, it will not be so entirely consumed as it ought to be.

Candles, Com′posite. Mould candles formed of a mixture of the hard fatty acid obtained from palm oil and the stearine of cocoa-nut oil. They were introduced in 1840. Other compositions are occasionally used, such as a mixture of spermaceti and hard white tallow, to which a little bleached resin is added.

Candles, Med′icated. These have been proposed as a convenient means of diffusing the active principles of certain volatile substances through the atmosphere, and for complete and partial fumigations. They are seldom employed in England.

Candles, Mercu″rial. From the red sulphide or the grey oxide of mercury mixed with wax, and a wick of cotton inserted therein. Recommended by Mr Colles for partial mercurial fumigation. They are burnt under a glass funnel with a curved neck, the upper orifice of which is directed to the diseased part.

Candles, Paraffin. From the beautiful translucent substance paraffin (which *see*). These candles surpass all others in elegance, and are entirely free from odour and greasiness. The light produced by 98 *lbs.* of paraffin candles is equal to that of 120 *lbs.* of spermaceti, or 138 *lbs.* of wax, or 144 *lbs.* of stearic, or 155 *lbs.* of the best composite candles (*Letheby*). They are sometimes delicately tinted with red, mauve, violet, crimson, and rose colour. Aniline colours will not dissolve in paraffin. Stearic acid, however, is a solvent for them, and accordingly when the candles are tinted with the coal-tar

colours these are previously dissolved in the stearic acid, always mixed with the paraffin. This insolubility of the aniline colours in paraffin has been suggested as a test for the purity of this hydrocarbon, and of its freedom from stearic or other fatty acids. For colouring paraffin candles black the paraffin is heated nearly to the boiling point which anacardium shells or nuts, which dissolve readily in the heated paraffin. The Belmontine Candles of Price's Patent Candle Company are formed of the paraffin of Rangoon tar.

Previous to the paraffin being made into candles, it is necessary that it should be purified and bleached. Many processes for effecting these ends have been devised. In the works of Price's Candle Company the method known as 'Hodge's' is had recourse to. This consists in first freeing the crude paraffin from the coarser impurities, melting it, casting it into cakes, and allowing it to cool sufficiently slowly, so as to form well-defined crystals The cakes are then placed upon a bed of some porous and absorbent material, and subjected to a temperature not sufficient to melt the paraffin, but only the liquid hydrocarbons and other more easily fused bodies, the latter running off from between the crystals of the paraffin, and being absorbed by the porous substance upon which the paraffin rests. This process is repeated until the removal of the liquid hydrocarbons from the solid paraffin has been satisfactorily accomplished. If it be requisite to subject the paraffin to further purification, the following method is frequently adopted:—The paraffin, previously melted by steam, is placed in a tank, with from 5% to 10% of strong sulphuric acid, and the mixture agitated for some hours by means of air (the time depending on the quality of the paraffin), the sulphurous acid fumes resulting from the reaction being carried off by a suitable contrivance. After the agitation is completed, the paraffin, after being allowed to stand for some time, is decanted into a suitable vessel containing animal charcoal, with which it is digested for some hours. Upon the subsidence of the charcoal the paraffin is drawn off, if at all turbid, and is passed through a funnel heated by means of a steam jacket.

Another method, the invention of Messrs Fordred, Lambe, and Sterry, for the decolorisation of the paraffin employed in candle manufacture, consists in digesting the paraffin at a temperature of 230° F. with about 12% of powdered fuller's earth. Of late this process has supplanted the charcoal one; and it may be employed, no matter by what means the previous purification of the paraffin has been carried out. The paraffin and fuller's earth are to be well agitated together, and when the latter has fallen down the clear paraffin is decanted from it. The inventors affirm that their process answers quite as well if marl clay, or any other similarly constituted and equally abundant natural substance, be substituted for fuller's earth; and that no matter which of these bodies is employed, they may be re-used, and any adhering paraffin be removed by washing with agitation, or by other suitable contrivances.

Messrs Smith and Field's patent for the removal of the colouring matters of the paraffin consists in the employment of silicate of magnesium. The patentees state that the successful issue of the operation depends not only upon the careful preparation of the salt used, but upon its being dried at a temperature of as exactly as possible 212° F. The careful preparation before insisted on of the magnesium salt, which is procured by the double decomposition of magnesium sulphate and sodium silicate, includes its thorough washing from adhering sodium sulphate previous to its desiccation. If this precaution be neglected, the porosity of the silicate will be impaired, and its bleaching effect more or less interfered with; and further, the patentees state that if the washed silicate be heated to redness, its decolorising power will also be lost.

It appears that the paraffin employed in making the candles consists of a mixture of paraffins having different melting-points. The following are the melting points of some of the chief varieties of paraffin:

Paraffin from Boghead coal at	45°—52° C.
„ „ Brown coal „	56° C.
„ „ Peat „	46·7° C.
„ „ Rangoon oil or tar	61° C.
„ „ Ozokerit	65·5° C.

Paraffin candles contain from 5% to 15% of stearin, this addition being made for the purpose of diluting the paraffin as well as for raising the melting-point of the paraffin where this is low. The stearin, moreover, serves to preserve the rigidity of the candle in the candlestick, and to prevent its bending out of the upright position. Paraffin candles are always moulded, but previous to this being done the moulds must be heated to a temperature above the melting-point of the paraffin; this may vary from 60°, 70°, and 87° C., according to the paraffin employed. The moulds having been filled with the melted paraffin are, after one or two moments only, plunged into cold water, when the candle immediately becomes solid. Unless this were done the candle would be spoilt, owing to the crystallisation of the paraffin. A thin wick is required for paraffin candles.

Candles, Spermace'ti. From spermaceti (which *see*). These are very delicate in appearance, but rather expensive. They burn well, but as the melting-point of spermaceti is low, 120° F., they will not bear carrying about in the hand without guttering. They are generally adulterated with stearic acid or hard white tallow.

In candle-making "spermaceti is usually mixed with 3% of wax or paraffin to destroy its highly crystalline structure; it is moulded in the usual way with plaited wicks that require no snuffing. Occasionally the spermaceti candles are cast without any admixture of wax, the moulds being raised to a higher temperature just as with stearic acid. Some manufacturers, in order to make the spermaceti appear like wax, use gamboge to give the desired tint; such candles are known as transparent wax" ('Chemistry, Theoretical, Practical, and Analytical'). Spermaceti candles are largely consumed in India.

Candles, Stear'ic. Under this head we may place the various sorts of candles moulded from the hard fatty acids of both animal and vegetable origin. The principal sources whence British manufacturers derive their acids are tallow, palm

oil, and cocoa-nut oil. The processes employed for separating them are generally described under STEARIC ACID. Candles formed of the fatty acids can now be prepared so as to imitate and almost rival those of wax and spermaceti; and they are quite as cheap as the nearly obsolete mould candles formed of common tallow. They are extremely hard; they do not grease the hands, and they burn away brightly and steadily, without giving off any offensive odour. Uncoloured, they are snowy white, but a yellow tint is frequently given them by gamboge.

Candles, Tal'low. From ordinary tallow, or from tallow which has been freed from much of its oleic acid by pressure. These have so unpleasant an odour, and are so apt to gutter, that they will probably ultimately disappear from use. They are, however, sold at so low a price, that among the lower classes they must long retain their hold. For dip candles the wicks are immersed in melted tallow, and after rubbing with the hands are placed straight and allowed to harden, after which they are arranged upon the 'broaches' ready for dipping. For mould candles the last operation is omitted. Great care is taken to select a cotton that yields the least possible quantity of ash after burning.

In the process of 'dipping,' the 'dipping cistern' being filled with tallow of a proper temperature from the boiler, one of the broaches covered with wicks is placed upon the end of the 'dipping beam,' and pressed down gently into the melted fat; it is then withdrawn, the bottoms of the candles just touched against a board placed on one side of the cistern for the purpose, and the frame removed to the rack. This operation is repeated until the candles acquire a sufficient size, when they are finally cooled, sorted, weighed, and strung in pounds for sale.

The mould candles once in common use were made of the finer kinds of tallow only; a mixture of 3 parts of sheep, with 1 part of ox suet, being preferred. See WAX.

Candles, Wax. These are most frequently made by pouring melted white wax on to the wicks, which are hung upon frames and covered with metal tags at the ends to protect the cotton from the wax in those parts. The frames are made to turn round, and melted white wax is poured first down one wick, and then the next, and so on. When the wicks have been subjected to this operation once and have become sufficiently cooled, they have a second, and then a third coat given them, until they are of the required thickness. The candles are next rolled into proper shape on a marble slab or wooden board. The conical top is moulded by properly-shaped tubes, and the bottoms are cut off and trimmed. Wax candles are now seldom moulded, but if so the same processes are followed as for stearic and paraffin candles. The large altar candles, which frequently weigh from 30 to 40 *lbs.*, are made by hand.

Wax Tapers. These, which are of various degrees of thickness, are not made of pure wax, but of wax (usually vegetable wax) and tallow, the latter being added to give them flexibility. When they are required to be coloured, resin and turpentine are added to the tallow. For further particulars consult Wagner's 'Chemical Technology,' "Candle-making."

CANDLE-NUTS. The kernels of the *Alearites triloba*, the candleberry tree, a plant growing in most tropical countries. The nuts, when dried and stuck upon a reed, are used by the natives of the Polynesian Islands as a substitute for candles. They contain a large amount of pure palatable oil, which is sometimes used by artists as a drying oil. After the expression of this oil the cake has been used as a food for cattle; also as a manure.

The following is the composition of the nuts:

Shells.	
Water	3·71
Organic matter	89·90
Mineral matter	6·39
Kernels.	
Water	5·27
Fat	62·97
Cellulose	28·99
Mineral matter	2·79
Ash of Kernel.	
Lime	18·69
Magnesia	6·01
Potash	11·33
Phosphoric acid	29·30

CAN'DLESTICKS. Metallic, earthenware, and porcelain candlesticks, snuffers, and snuffer-stands are recommended to be cleaned by pouring boiling hot water on them (previously placed in an earthen pan), and, after wiping them quite dry with a cloth, to clean them with a piece of wash-leather; those made of silver, or of plated copper, may be finally polished with a little plate powder; those of white metal with a little whiting or fine chalk, and those of brass, with a little rotten-stone or one of the polishing pastes. For articles of this kind, made of bronze and papier-maché, the water should be used only hot enough to melt the tallow, and they should be only gently dabbed or rubbed off with a very soft cloth or leather. The common practice of placing candlesticks before the fire to melt off the grease is injudicious, as the solder or japan about them is almost certain to be injured. Hence the common annoyance of damaged or 'crippled' candlesticks in houses where there are careless servants.

CAN'DYING. When the object is simply to form a confection or sweetmeat, imbued with the aroma, flavour, or medicinal property of any substance, candies are generally prepared by simply boiling lump sugar with a sufficient quantity of the infusion, decoction, tincture, expressed juice, or sometimes even the powder of the particular article, until a portion taken out and cooled becomes quite solid, when it is either poured out on a marble slab, or into tin, marble, or paper moulds, dusted with powdered lump sugar.

When the object is to preserve the form and character of the vegetable in the candy, the substance is boiled in water until soft, and then suspended in concentrated syrup (in the cold), until they become transparent; after which they are either dried in a current of warm air, or in a stove, at a heat not exceeding 120° F. The syrup must be kept fully saturated with sugar by reboiling it once or twice during the process.

Another method occasionally employed by confectioners for almonds and the like is to put the substances into a syrup boiled until it forms a small thread between the opening fingers, and to stir the whole until it is nearly set. See SUGAR BOILING.

The following are the principal candied articles kept at the shops:

Candied Al'monds. From blanched almonds, roasted and halved.

Candied Angel'ica. *Prep.* 1. From the root. Boil the fresh roots (after slicing them and removing the pith) in water, to deprive them of part of their bitterness and aroma; then drain them and put them into syrup boiled to a full candy height, and boiling hot; let them remain until nearly cold, when they may be taken out and carefully dried.

2. From the stems. From the tender stems, stalks, and midribs of the leaves, as last. Used as a sweetmeat and dessert. It is said to be cordial, stomachic, tonic, and aphrodisiac.

Candied A'pricots. From the fruit, scarcely ripe, either whole or cut into quarters, immersed in the syrup (hot), without any further preparation.

Candied Cit'rons. From the peels.

Candied Erin'go. From the roots, slit and washed.

Candied Gin'ger. From the roots of green ginger.

Candied Hore'hound. From a strong decoction or infusion of the root, and lump sugar, 1 pint to 8 or 10 lbs. may be used. Boil the mixture to a candy height, and pour it whilst warm into moulds or small paper cases well dusted with finely powdered lump sugar; or pour it on a dusted slab and cut it into squares.

Candied Lem'on Peel. As Candied Citron.

Candied Or'ange Flow'ers. From the flowers deprived of their cups, stamina, and pistils (2 oz. to each 1 lb. of sugar), as Candied Almonds, but poured out on a slab.

Candied Or'ange Peel. From the peel of the Seville orange, or common orange, as Candied Citron.

Candied Su'gar. See SUGAR BOILING.

The following are articles of a more special character:

Candy, Car'away. 1. From caraway seeds (in fine powder), ½ oz.; sugar, 1 lb.

2. Oil of Caraway, 1 dr.; sugar, 1 lb.

Candy, Diges'tive. *Syn.* LIVE-LONG CANDY. *Prep.* 1. Rhubarb and bicarbonate of soda, of each 1 dr.; ginger, ½ dr.; cinnamon, 20 gr. (all in fine powder); heavy magnesia, 1 oz.; powdered sugar, 2 oz.; mucilage of tragacanth, q. s. to form a lozenge mass; to be divided into small squares of 18 or 20 gr. each.

2. As the last, but adding finely powdered caraways, 1 dr.; oil of caraway, 15 drops; and sugar, 1 oz. Both are used as heartburn and digestive lozenges.

Candy, Gin'ger. *Prep.* 1. From ginger (in coarse powder), 3 oz.; boiling water, 1¼ pint; macerate in a warm place for 2 hours, strain, add lump and moist sugar, of each 5 lbs., and boil to a candy.

2. Ginger (in very fine powder), 1 oz.; powdered sugar, 2 lbs.; syrup, q. s. to make a paste. Stomachic and carminative.

For various sweetmeats which might come under the head of CANDY, see CONFECTIONS, DROPS.

CAN'KER. This disease consists in a depraved condition of that part of the sensitive foot of the horse which secretes the horny frog and sole. It mostly occurs in coarsely bred animals, and is the result of filth, damp, and bad ventilation. The treatment consists in first removing all loose horn, and allowing all pent-up matter to escape; the exuberant granulations must be carefully cut away, and the parts then washed with a tepid lotion of sulphate or chloride of zinc; after drying the surface dust it with oxide of zinc; apply tow dipped in a mixture of tar and lime, and "keep it in firm contact with the parts by means of a leather sole or strips of hoop-iron underneath a shoe lightly tacked on. Dress in this manner daily, keeping up the dry pressure for a week" (*Finlay Dun*).

CAN'NON METAL. See GUN METAL.

CANTHAR'IDES. *Syn.* SPANISH FLIES, BLISTERING F., LYT'TÆ; CANTHAR'IS, B. P. The *Cantharis vesicatoria* of Latreille, commonly known as the Spanish fly, is an insect of the order COLEOPTERA; it abounds in the south of France, Spain, and Italy; and has spread into Germany and the south of Russia. When alive it exudes a strong fetid and penetrating odour.

Pur., &c. These insects should be preserved in well-closed bottles or tin canisters. The addition of a few drops of oil of cloves, or of strong acetic acid, or even of a few cloves in substance, will preserve them unchanged for a length of time in closed vessels. The best proof of their goodness is the smell. The powder is constantly adulterated. The plan of the wholesale druggist is to sort out the most worthless flies for powdering, and to compensate for their deficiency of vesicating power by adding 1 lb. of euphorbium to every 12 or 13 lbs. of flies. When a superior article is required, liquorice powder is added (4 or 5 lbs. to every 14 lbs.), along with about 1 lb. of euphorbium, and sufficient blue-black or charcoal to turn the yellow of the liquorice to a greenish colour. The best mode of detecting this adulteration is by the microscope. It should be borne in mind that only those flies which have attained their full growth possess blistering properties. The immature or undersized insects are destitute of epispastic power.

Ant. An emetic of sulphate of zinc, followed by the stomach-pump, if necessary. The vomiting may be promoted by copiously drinking warm bland diluents, such as broth, linseed tea, milk, &c. Friction on the spine, with volatile liniment and laudanum, and the subsequent administration of draughts containing musk, opium, and camphorated emulsion, have been strongly recommended.

Tests. By the microscope very minute particles may be discovered in the stomach and intestines, on a post-mortem examination. Orfila thus found particles of cantharides in a body that had been interred nine months.

Uses, &c. Spanish flies are used externally to raise blisters, and internally as a stimulant and diuretic, generally in the form of tincture. In excess they produce strangury, bloody urine, saty-

riasis, delirium, convulsions, and death. See TINCTURES, BLISTER, VESICANTS, &c.

CANTHAR'IDIN. $C_{10}H_{12}O_4$. This substance is found in, and is the vesicating principle of, the Spanish fly, Chinese blistering fly, and other coleopterous insects. *Prep.* Pulverised cantharides are allowed to remain in contact for 24 hours with twice their weight of chloroform, in a displacement apparatus. The chloroform is then drained off, and finally displaced by alcohol, and the solution is left to evaporate. The cantharidin crystallises out, saturated with green oil. In order to purify the cantharidin it is laid on bibulous paper, which absorbs the greater part of the oil, and then crystallised out of a mixture of alcohol and chloroform (*Procter*).

Another Process. 30 grms. of the powdered flies is washed with petroleum ether, to remove fat. The flies are now moistened with solution of soda, and dried on a water-bath. The dried powder is shaken with 30 grms. chloroform and then made strongly acid with hydrochloric acid; 30 grms. of ether is now added, the mixture well shaken, and the ether chloroform solution removed and shaken with water. The shaking of the residue with ether is repeated until cantharidin ceases to be removed. On evaporating or distilling off the ether; cantharidin is obtained as a residue. It is finally washed first with alcohol, second with water (*Greenish* and *Dragendorf*).

Prop. Prismatic crystals, melting at 210° C., which volatilise in white fumes, strongly irritate the eyes, nose, and throat, and condense in rectangular prisms. Cantharidin is insoluble in water, but soluble in ether, chloroform, acetic acid, and in the fixed and volatile oils, and in hot alcohol, which deposits it on cooling. Its solution in any of the liquids above mentioned possesses vesicating properties, which, however, are not exhibited by solid cantharidin.

CAOUT'CHOUC. *Syn.* INDIA RUBBER, ELASTIC GUM. India rubber is the concrete juice of the *Ficus elastica, Siphonia elastica,* the *Urceola elastica,* and many other tropical plants.

The *Siphonia,* or *Hevea* trees, grow in all parts of the basin of the Amazon, and yield the Brazilian caoutchouc, also known as Para india rubber. The *Hevea* is a euphorbiaceous tree, which, through the energy of Clements R. Markham, was introduced to India, where it is cultivated at the foot of the Himalaya, in the Durrung district of Assam, together with the *Ficus elastica.* The trees may be tapped at the age of 25 years. After 50 years they will yield 40 lbs. of caoutchouc every third year.

Clements R. Markham states that "in the Amazon valley the scene presented by an encampment of caoutchouc collectors is very picturesque. The collector makes small holes in the bark, to which tubes of clay are fixed, these lead the milk to bamboo receptacles; the contents of these when full are poured into the carapace of a large tortoise. The milk is subjected to the process of smoking without delay; in this process the milk is exposed to the smoke of the nuts of the *Attalea excelsa* palm. The milk is poured over a light wooden shovel and thrust into the smoke, soon becoming yellow and firm. Thus they add layer upon layer until a good thickness is obtained. The *plancha* or slab is then finished, taken off the shovel by cutting down one side, and hung in the sun to dry."

Prop., &c. The general properties of india rubber, as well as its numerous applications, are well known. The fresh juice has a cream-like appearance and consistence, is coagulated by heat, and is miscible with water, alcohol, and wood naphtha; sp. gr. 1·012 to 1·041; it yields from 18% to to 45% of solid caoutchouc, either by heat or evaporation. By excluding it from the air it may be preserved unchanged for a considerable period.

Solid caoutchouc has a sp. gr. about ·925, it melts at 248° F. into a viscid mass, which does not again harden on cooling; it is unaltered by chlorine, hydrochloric acid, sulphurous acid, fluosilicic acid, ammonia, caustic alkaline lyes (even when boiling), and most similar substances; nitric acid and sulphuric acid act on it when concentrated. Some specimens of caoutchouc are harder than gutta percha itself, and equally inelastic, whilst others never perfectly solidify, but remain in a condition resembling that of birdlime or printers' varnish.

The best solvents of caoutchouc are rectified sulphuric ether (which has been washed with water to remove alcohol and acidity), chloroform, bisulphide of carbon, a mixture of bisulphide of carbon and absolute alcohol (24 of the first to 6 or 7 of the last), and caoutchoucin. All these liquids dissolve india rubber rapidly in the cold, and leave it unaltered on evaporation. The first two are, however, too expensive to be generally employed. The others have a disagreeable odour, but are much cheaper than the rest, and possess the advantage of leaving the film of caoutchouc in a firmer and stronger condition than other solvents. Pyrogenous oil of turpentine is another cheap and good solvent. Benzol, rectified mineral or coal-tar naphtha, crude petroleum, and oil of turpentine dissolve india rubber by long digestion and trituration (with heat), otherwise they merely form with it a glutinous jelly that dries very slowly and imperfectly, leaving it much reduced in hardness and elasticity. The fats and fixed oils also readily dissolve caoutchouc (with heat), forming permanently glutinous solutions or pastes; so also do most of the volatile oils, but the solutions with the majority of them dry with difficulty.

One of the most remarkable properties of india rubber is the great amount of heat which is disengaged during its condensation by pressure or in the exercise of its elasticity. During the process of kneading the raw caoutchouc in the 'masticators,' the cold water thrown in to reduce the temperature soon becomes boiling hot. When no water is added, a temperature so high is often reached as to occasion the melting of the rubber. This is particularly the case during the process of 'dry kneading' with quicklime. A tube $2\frac{1}{4}$ inches in diameter, impactly secured, was subjected to a force of 200 tons. The result was a compression amounting to 1-10th; great heat was evolved, and the excessive elasticity of the substance caused a fly-wheel weighing 5 tons to recoil with alarming violence. Mr Brockenden states that he succeeded in raising the tempera-

ture of an ounce of water 2° in about 15 minutes by collecting the heat evolved by the extension of a small thread of caoutchouc. He refers this effect to the change in specific gravity, and contends that the heat thus produced is not due to friction, because the same amount of friction is occasioned in the contraction as in the extension of the substance, and the result of this contraction is to reduce the caoutchouc thus acted upon to its original temperature.

The edges and surfaces of india rubber are readily and perfectly joined by mere contact and intense pressure. On the small scale the edges may be moistened with ether, naphtha, oil of turpentine, or some other solvent, or by long boiling in water, and immediately pressed tight together and held in contact for some time.

Elastic tubes are readily formed of india rubber by cutting it into uniform slips of proper thickness, and winding them round rods of polished glass or metal, so that the edges are in close contact or 'overlapping.' A piece of tape is then wound round outside it, and the whole boiled in water for 2 or 3 hours, after which time the edges will be found to be sufficiently adherent. A better plan is to immerse the 'rubber' in a mixture formed of bisulphide of carbon, 95 parts, and rectified spirit, 5 parts, until it swells into a pasty mass, which may then be moulded into any desired form, or passed through the die of a tubing machine. For chemical purposes, brewing, &c., vulcanised india-rubber tubing has now taken the place formerly occupied by the unprepared material.

The once celebrated 'Mackintoshes' are made by spreading two or more coats of a paste made of caoutchouc and rectified coal-tar naphtha over the surface of the stuff or cloth, and, when it has become partially dry, pressing two such surfaces evenly together by passing the goods between a pair of cylinders or rollers. The articles are then placed in a stove-room for the composition to harden, and to remove the odour of the naphtha. Of late years vulcanised or mineralised rubber (coloured) has been used for this purpose, and being spread on the outside of the stuff, instead of the inside, forms an ornamental and thoroughly waterproof material.

India-rubber thread is prepared by stretching it (previously cut into coarse filaments) to 5 or 6 times its length in boiling water or hot air, in which state it is allowed to cool slowly. This process is repeated again and again until it reaches 16,000 or 17,000 times its original length, when it is glazed by agitating it with powdered sulphur or French chalk. This thread is readily joined or 'pieced,' as it is called, by paring the ends obliquely with a pair of scissors or a knife, and then pressing the clean ends strongly together with the fingers. When the coarse filaments from the cutting machine are simply stretched with the moistened thumb and finger in the act of 'reeling' to about 8 or 9 times their length, they are said to be 'inelasticated,' and are ready to be made into elastic braces, elastic web, and other like elastic tissues and fabrics in the braiding machine.

India rubber is employed for a great variety of purposes. It is used for packing piston-rods, valves for pumps, washers for joints, driving-belts, buffer-springs, and gas-tubing. As an insulating material it is very valuable; in the hard form of ebonite it is employed for battery cells and magnetic coils, extensively used for making combs, photographic baths, syringes, taps, and ornamental objects most numerous. Rubber fabrics are employed for waterproof clothing, sheeting, aprons, diving-dresses, water and air-beds, door-mats, and fishing-stockings.

Caoutchouc, Facti″tious. See OIL, CONSOLIDATED.

Caoutchouc, Vul′canised. *Syn.* VULCANISED INDIA RUBBER, MINERALISED I. R., SULPHURETTED I. R. The discovery of the singular action of sulphur and the mineral sulphides on caoutchouc was made by Mr Charles Goodyear, of New York, in 1842, at which date the manufacture of vulcanised india rubber may be said to have commenced. In 1843 Mr Thomas Hancock patented a process for vulcanised india rubber in these countries, founded on that of Mr Goodyear. A sheet of caoutchouc immersed in melted sulphur absorbs a portion of it, and at the same time undergoes important changes in many of its leading characteristics. So prepared, it is no longer affected by changes of temperature; it is neither hardened by cold nor softened by any heat sufficient to destroy it. It loses its solubility in the solvents of ordinary caoutchouc, whilst its elasticity is greatly augmented, and has become permanent.

The same effect is produced when sulphur is kneaded into caoutchouc in a masticator, or by means of powerful rollers, as well as when common solvents (naphtha, spirit of turpentine, &c.) are charged with a sufficient amount of sulphur in solution to become a compound solvent of the rubber. In these cases articles may be made of any required form before heating them for the change of condition technically termed 'vulcanisation.' It is necessary, however, for this purpose, that the form should be carefully maintained, both before and during the exposure to the heat.

"A vulcanised solid sphere of $2\frac{1}{2}$ inches in diameter, when forced between two rollers $\frac{1}{4}$ inch apart, was found to maintain its form uninjured. In fact, it is the exclusive property of vulcanised caoutchouc to be able to retain any form impressed upon it, and to return to that form on the removal of any disturbing force which has been brought to act upon it" (*Brockedon*).

Caoutchouc combines with from 12% to 15% of sulphur; the quantity of sulphur added to the naphtha paste should not, therefore, exceed 10% or 12% of its weight. About 2% of sulphur appears to enter into combination with the caoutchouc; if more than this be used it can be dissolved out by sulphur solvents. An excess of sulphur renders caoutchouc less durable. It is less affected by solvents than pure caoutchouc. Vulcanised rubber is often adulterated with 40% to 50% of mineral matter.

The temperatures for vulcanisation by the common method range from 320°—330°; and the period required is one hour, or more, according to the temperature. A much lower temperature is, however, sufficient if the duration of the exposure is

much extended or the compound mass is softened with any of the common solvents of india rubber.

The process of sulphuring, or mineralisation, is differently conducted in different manufactories. Under Mr Burke's patent, oxysulphide or amorphous sulphide of antimony (formed by decomposing a solution of crude antimony in a lye of potash or soda with hydrochloric acid) is employed. This powder he combines with either india rubber or gutta percha, or mixtures of them, by kneading in a 'masticator' for 2 or 3 hours, and after strong compression in a mould whilst still warm, he exposes the mass to a steam heat ranging from 250°—280° F. The block, so prepared, is afterwards cut into sheets, &c. The advantages possessed by the product are that it possesses no unpleasant odour, nor does the sulphur effloresce on its surface, as in ordinary vulcanised india rubber.

Under Mr Christopher Nickel's patent (1849) 1 part of sulphur is kneaded with 6 parts of caoutchouc, and then pressed into moulds, as before. He also vulcanises rubber by exposing it in a cylinder heated in a steam jacket to the fumes of sulphur or to sulphuretted gases, given off from a retort connected with the apparatus. The rubber thus prepared he next subjects to hydraulic pressure in moulds, at a temperature ranging between 220° and 250° F.

Small articles or sheets of india rubber may be extemporaneously vulcanised at common temperatures by simple immersion, for a minute or two, in a mixture of bisulphide of carbon, 97½ parts, and protochloride of sulphur, 2½ parts; after which they must be well washed first in weak alkaline lye, and next in pure water. Mr Parkes employs 100 instead of 97½ parts of the bisulphide. This method is termed 'cold sulphuring.'

An excellent method of vulcanisation, recommended by Mr Parkes, particularly applicable to small articles, consists in immersing them for about 3 hours in a close vessel containing a solution of polysulphide of potassium at 25° Baumé (sp. gr. 1·197), and of the temperature of 240° F. It is afterwards washed in an alkaline lye, then in pure water, and dried.

Among the many applications of vulcanised india rubber those connected with its elasticity and its enormous contractile power when extended are particularly striking. Under Mr E. Smith's patent, 'torsion springs' for roller-blinds, door-springs, clock-springs, carriage-springs, &c., are made of it. Mr Hodges, in another patent, has availed himself of the same property as a new mechanical power. Short lengths of caoutchouc, which he terms 'vulcanised power purchases,' are successively drawn down from or lifted to a fixed bearing, and attached to any weight which it is required to raise; when a sufficient number of these power purchases are fixed to the weight, their combined elastic force lifts it from the ground. Thus, 10 purchases of the elastic strength each of 50 *lbs.* raise 500 *lbs.* Each purchase is 6 inches long, and contains about 1½ *oz.* of vulcanised caoutchouc. These 10 purchases, if stretched to the limit of their elasticity (not of their cohesive strength), will lift a weight exceeding 650 *lbs.*

The same principle has been applied to relieve and equalise the strain on ships' cables, especially where several boats are towing one vessel; and as a projectile force. A number of power purchases, attached to the barrel of a gun constructed to project harpoons, will exert a power, if suddenly relieved, proportioned to their aggregate forces. By similar contrivances balls may be projected 200 yards or more, and a charge of No. 4 shot can be thrown 120 yards. A bow, in which the string alone is elastic (the reverse of the usual form), has been contrived which throws a 30-inch arrow 170 yards.

The last great improvement in the manufacture of caoutchouc is the discovery that by continuing the process of vulcanisation for a longer time at an increased heat and under pressure, a hard black substance is obtained, which can be turned in a lathe like ebony. This substance has already been applied to an extraordinary number of uses. See VULCANITE.

An exceedingly useful combination of cork and india rubber has lately been introduced. See KAMPTULICON.

CAOUT'CHOUCIN. An extremely light fluid obtained by distilling india rubber.

Prep. (*Barnard's* patent process.) A highly volatile fluid, discovered by Mr Barnard. India rubber or caoutchouc, as imported, cut into small lumps, containing about 2 cubic inches each, is thrown into a cast-iron still, connected with a well-cooled worm-tub (any flat vessel with a large evaporating surface will do, the entire top of which can be removed for the purpose of cleaning it out); and heat is applied in the usual way, until the thermometer ranges to about 600° F., when nothing is left in the still but dirt and charcoal. The dark-coloured fetid oil which has distilled over is next rectified along with 1-3rd its weight of water, once or oftener; and at each rectification becomes brighter and paler, until at about sp. gr. ·680 it is colourless, and slightly volatile. The product is then shaken up with nitro-hydrochloric acid, or chlorine, in the proportion of a ¼ of a pint of the acid to 1 gall. of the liquid. To enable the dirt to be the more easily removed from the bottom of the still, common solder, to the depth of about ½ an inch, is thrown in.—*Prod.* 80%.

Prop., &c. Mixed with alcohol, caoutchoucin dissolves gums and resins, especially copal and india rubber, at the common temperature of the atmosphere, and it speedily evaporates, leaving them again in the solid state. It mixes with the oils in all proportions. It has been used in the manufacture of varnishes, and for liquefying oil paints, instead of turpentine. It is very volatile. and requires to be kept in close vessels. According to the researches of Himly, Gregory, and Bouchardat, the caoutchoucin of Barnard consists of several liquids, some of which have the composition of olefiant gas, and others that of oil of turpentine.

CA'PERS. The flower-buds of various species of *Capparis*, particularly *C. spinosa*, caper tree, preserved in vinegar. They are chiefly imported from Spain, Italy, and the south of France, where the caper tree is largely cultivated for the purpose. The flower-buds are picked daily, and thrown into a cask of strong pickling vinegar

until it becomes full, when it is sold to the dealers by the collector. The former sort them into different sizes by means of copper sieves, in a similar way to that adopted for lead shot and gunpowder. In this way they are divided into nonpareilles, capuchins, capotes, seconds, and thirds, of which the former, or smallest, are regarded as the best; but much depends upon the quality of the vinegar.

The bright green colour of capers, so much valued by the ignorant, arises chiefly from the presence of copper derived from the sieves used in sorting them. In many cases, copper coin, as sous and halfpence, are added for the purpose. Thus the eye is gratified at the sacrifice of the stomach, and an insidious poison introduced into the system simply to give an unnatural appearance to a condiment which tastes better without it. See COPPER.

CAPILLAIRE'. [Fr.] Simple syrup, or a concentrated solution of sugar in water, flavoured with orange-flower water or some other similar aramatic. The name was originally given to a mucilaginous syrup, prepared by adding to an infusion of maiden-hair (*Adiantum capillus veneris*) some sugar and orange-flower water.

CAP'NOMOR. See KAPNOMOR.

CAPRIC ACID, $C_{10}H_{20}O_2$. *Syn.* DECOIC ACID; RUTIC ACID; ACIDUM CAPRICUM, L. An acid of the acetic series, found by Chevreul to exist in butter. It occurs also (in combination) in cocoanut oil, fusel oil, Limburg cheese, and wool.

Prep. It can be prepared from oleïc acid by distillation or oxidation by nitric acid; or primarily by the saponification of butter with potash or soda. The soap obtained by the last-named method is decomposed by hydrochloric acid, and the free acids are obtained, viz. butyric, caproïc, caprylic, and capric. The barium salts may be formed by the addition of barium hydrate, and separated by taking advantage of their unequal solubility. The free acid is obtained from the barium caprate by decomposing it with boiling dilute sulphuric acid; barium sulphate is precipitated, while capric acid remains in solution, and may be crystallised out.

Prop. It is a crystalline, colourless substance, with an odour like that of a goat, especially on heating. M. Pt. 30° C. (86° F.); B. Pt. 269° (516° F.). It is soluble in alcohol and ether, and slightly in boiling water.

CAPROIC ACID, $C_6H_{12}O_2$. *Syn.* ISOHEXOIC ACID, ISOBUTYL-ACETIC ACID. There are six acids of this formula known; but this one is the most commonly occurring of them. It is found in butter, cheese, cocoa-nut oil, the flowers of *Satyrium hircinum*, which have an odour of bugs, and in the sarcocarp of *Gingko biloba*. It can be made from butter in the same way as capric acid. It is a liquid with a rancid smell.

CAPSAICIN. Until the researches of Dr Thresh proved to the contrary, the active principle of the capsicum fruit or cayenne pepper, and the one to which it was thought it owed its acrid and pungent properties, was believed to be an alkaloid, and was named capsicine in consequence. Dr Thresh succeeded in obtaining an alkaloid from the capsicum, but this was entirely wanting in acridity and pungency. Its discoverer states that capsaicin occurs only in the pericarp of the fruit. The details of the process by which it may be obtained are given in the 'Year-Book of Pharmacy' for 1876–77.

A specimen of capsaicin which Dr Thresh believes to have been in a pure condition was sent to Dr Flückiger's laboratory for analysis, and Dr Buri, by whom the combustion was made, reports that it gave the following composition: $C_{19}H_{14}O_2$, a result which Dr Thresh found to agree very fairly with some capsaicin derived from a specimen fruit obtained from a different source from that sent to Dr Flückiger. Administered internally in doses of $\frac{1}{25}$ grm., capsaicin gave rise to violent griping and purging; and when a lotion consisting of 1 part diluted with 40 parts of glycerin and spirit was placed on the arm, it soon gave rise to such pain, and caused so much inflammation that the lint which was wetted with the solution had to be removed very shortly after being applied.

CAP'SICUM. [L. and Eng.] *Syn.* CHIL'I, RED PEPPER. A genus of plants belonging to the Nat. Ord. SOLANACEÆ, species of which yield the fruits which are used to form Cayenne pepper and Chili vinegar. The officinal capsicum of B. P. is the fruit of the species *C. fastigiatum.* See PEPPER, TINCTURES, VINEGARS.

CAP'SULES. This term is now commonly applied to small egg-shaped or spherical vessels, in which medicines are placed for the purpose of covering their nauseous taste at the time of swallowing them. They are made of gelatin, mixtures of sugar and gelatin, animal membrane or other soluble substances.

Capsules, Gel'atin. *Prep.* 1. By dipping the bulbous extremity of an oiled metallic rod into a strong solution of gelatin. When the rod is withdrawn, it is rotated, in order to diffuse the fluid jelly equally over its surface. As soon as the gelatinous film has partially hardened, it is removed from the mould and placed on pins, furnished with suitable heads, and fixed on a cork table. When sufficiently dry, the capsules are placed upright in little cells, made in the table to receive them, and the liquid with which they are to be filled is then introduced by means of a small glass tube. They are next closed by dropping some of the melted gelatin on the orifice of each. 6 parts of gelatin and 1 part sugar are now the common proportions.

2. (*Simonin.*) Oval balls of wax of the requisite size are prepared by pouring wax into a wooden mould, consisting of two parts, and arranged for the reception of a row of these balls. These are afterwards stuck on iron needles, affixed to rods of convenient size, in rows. The balls are now uniformly coated all at once by dipping in the usual manner, then removed from the needles, and are next placed with the needle-holes downwards, on a gently heated plate, when the wax flows out, and a round capsule is left behind.

Cap'sules, Gel'atin and Su'gar. *Prep.* (*Giraud.*) Gelatin, 6 parts; solution of gum and simple syrup, of each, 1 part; water, 5 parts; melt in a water-bath, remove the scum, and proceed as before.

Capsules, Glu'ten. These, which form the subject of a French patent, are said to be formed of

the gluten of wheat-flour, a substance which is insoluble, although softened, by water. We have placed these capsules for 24 hours in warm water, and found them, at the expiration of that time, still unbroken, the enclosed medicine being completely enveloped. The mode of preparation is kept secret.

Capsules, Mem'branous. *Syn.* ORGAN'IC CAPSULES. From gut-skin moistened and stretched over an oiled bulb of glass or metal, and filled in the common way. These have been patented, but they do not appear to be an improvement on the common capsule of gelatin.

Obs. The common capsules usually hold about 10 or 12 gr. of balsam of copaiba. Those of the shops are sometimes filled with adulterated copaiba.

Balsam of copaiba (capivi) and oil of cubebs, or a mixture of them, castor oil, cod-liver oil, oils of sandal-wood, amyl nitrite, phosphorus, extract of male fern, and tar are the substances most usually administered in this way. *Baccæ copaiferæ factitiæ* are officinal in the Ph. Castr. Ruth. Ratier has proposed to grease them and administer them per anum. Ricord has strongly recommended capsules of copaiba, coated with extract of rhatany, as much superior to the common ones of copaiba alone, in the treatment of gleet and gonorrhœa. They may be easily prepared by either of the following methods:

1. By immersing, for an instant, the common capsule in a mixture of extract of rhatany (newly prepared from the root), 3 parts; syrup of moist sugar, 1 part; mucilage of gum arabic, 1 part; melted together in a water-bath.

2. By forming the bodies of the capsules with the above mixture or composition, instead of with gelatin, and then following the same manipulations as for the manufacture of the common gelatin capsules.

These capsules are said to sit well upon the stomach, the tone of which they contribute to improve, and to act with greater certainty than those made of copaiba and gelatin alone.

CAR'AMEL. A dark-brown substance obtained by heating sugar. It is formed during the roasting of all materials containing sugar, such as coffee and malt. It is much used for colouring soups, wines, spirits, and other liquids.

Caramel, Crude. *Syn.* SPIRIT COLOURING, BURNT SUGAR. *Prep.* From cane-sugar, by heating it to from 410°—428° F., as long as aqueous vapour is formed; dissolving the product in water, and concentrating the solution by evaporation.

Caramel, Pure. *Prep.* 1. (*Graham.*) Crude caramel, obtained as above, is placed on a parchment-paper dialyser. The undecomposed sugar and certain intermediate compounds diffuse out with considerable facility, and what ultimately remains on the dialyser possesses 5 times the colouring power of the original crude caramel, weight for weight. See DIALYSIS.

2. (*Peligot.*) Add strong alcohol to a filtered aqueous solution of crude caramel until it ceases to produce a precipitate; collect the precipitate, which is caramel, on a filter, wash with alcohol, and dry. Graham recommends that the product should be dissolved and precipitated 4 or 5 times, or till the mass thrown down, from being plastic at first, becomes pulverulent.

3. (*J. J. Pohl.*) Cane-sugar is heated in a spacious metallic vessel by means of an oil-bath to 410° or 419° F. as long as aqueous vapours escape, the mass being occasionally stirred with a spatula. The mass is then finely powdered and digested with alcohol for 2 or 3 hours; the digestion is repeated until the fluid no longer tastes bitter.

Prop. A solution containing 10% of purified caramel is gummy, and forms a tremulous jelly on standing. Evaporated *in vacuo*, it dries up into a black shining mass soluble in water; but if the solution be evaporated to dryness by the heat of a water-bath, the whole matter is rendered insoluble in hot or cold water. A very small proportion of caramel suffices to give a rich sepia tint to water.

Detection of Caramel in Wines and Spirits. 10 parts of the sample is mixed with 30 to 50 c.c. of paraldehyde and then with alcohol until the liquids mix. If caramel is present there is formed in 24 hours a precipitate of a brown colour. The precipitate can be collected by decantation and filtration.

CARANA. The gum-resin of *Icica sp.*, extracted by the Maquiritare and Piaroa Indians on the Orinoco. Used in medicine for plasters.

CAR'AT. A weight of 4 gr. used in weighing diamonds, which are spoken of as of so many carats weight. Among assayers a carat is a weight of 12 gr.; but more commonly a proportional weight or term, representing the number of parts of pure gold in 24 parts of the alloy; pure gold being spoken of as of 24 carats fine. It is commonly the 24th part of the 'assay pound,' and is nominally subdivided into 4 assay grains and these again into quarters. See ASSAYING.

CAR'AWAY. *Syn.* CARAWAY SEED; SE'MINA CARUI, L.; CARUI FRUCTUS, B. P. The fruit of the *Carum Carui*, Linn., an umbelliferous plant, common in England and other parts of Europe. These fruits, commonly called 'seeds,' form an agreeable and useful aromatic and carminative, and are especially esteemed in the flatulent colic of children. They are also largely employed as an adjuvant or corrective in various officinal preparations, and as a flavouring ingredient in cakes, biscuits, cordials, confectionery, &c. See ESSENCES.

CARBAZOT'IC ACID. See PICRIC ACID.

CARBOHYDRATES. A group of compounds containing carbon combined with hydrogen and oxygen, the last two elements being present in the proportion in which they unite to form water. Many of them are important constituents of plants, and a few are found also in the animal kingdom, whilst the larger number form valuable articles of food. Most of them exhibit active optical properties, rotating the plane of polarised light either to the right (marked with a + below), or to the left (−). They are divided into three groups, which are enumerated below; all the members of the same group have an identical chemical composition.

1. *Saccharoses.* $C_{12}H_{22}O_{11}$. + Cane-sugar, or saccharose; + milk sugar; + melezitose; + melitose; + trehalose; + maltose.

2. *Glucoses.* $C_6H_{12}O_6$. + Grape-sugar, glucose, or dextrose; − fruit-sugar, or levulose; + galactose; + arabinose; + eucalyn; − sorbin; inosite; scyllite; dambose.

3. *Amyloses.* $C_6H_{10}O_5$. + Starch; + dextrin; − inulin; laevulin; + glycogen; gums; cellulose.

Of the members of the first group, cane-sugar when boiled with dilute acids yields equal quantities of grape-sugar and fruit-sugar, milk-sugar yields grape-sugar and galactose, melitose grape-sugar and eucalyn, whilst the others apparently yield only grape-sugar. Owing to the lævorotatory power of fruit-sugar (levulose) being greater than the dextrorotatory power of grape-sugar (dextrose), the mixture of grape-sugar and fruit-sugar obtained from cane-sugar, which is itself dextrorotatory, is lævorotatory, and is hence termed *invert-sugar*.

The members of the amylose group are in a similar manner transformed into glucoses by the action of acids.

Most of the glucoses yield a red precipitate of cuprous oxide when boiled with Fehling's solution.

For further information, see the respective compounds.

CARBOLIC ACID. C_6H_5OH. *Syn.* PHENOL, PHENIC ACID, PHENIC ALCOHOL; ACIDUM CARBOLICUM, L.; ACIDE CARBOLIQUE, PHÉNOL, Fr.; CARBOLSÄURE, PHENOL, Ger. A powerful antiseptic substance derived from coal-tar oil. Creosote contains only very small quantities of it.

Prep. 1. It is prepared from the portions of coal-tar which distil over between 150° and 200° C. (300°—400° F.), the so-called 'middle-oil.' This, after the larger quantity of the naphthalene contained in it has crystallised out, is treated with caustic soda of sp. gr. 1·34, and the mixture well worked in a cylinder by means of an aspirator.

After standing for some time the lower layer is drawn off from the upper (which consists of hydrocarbons), diluted with water and allowed to stand in contact with air, when naphthalene and tarry products separate. The aqueous solution is fractionally precipitated by dilute sulphuric acid, tarry matters separating out first, then the homologues of phenol, and lastly phenol itself.

2. In other works the decomposition is complete in one operation, and the tar-acid separated by distillation, the portion boiling between 175°—200° C. (350°—400° F.) being collected separately as the crude carbolic acid of commerce. By repeated fractional distillation, and by cooling the portions boiling between 180° and 190° C. (355° and 375° F.), crystalline phenol is obtained, which, however, still contains more or less paracresol. In order to obtain it chemically pure, its hydrate with water is formed; this crystallises at a low temperature. It is separated from the residual liquid and distilled, when it gives water and phenol.

Prop. Phenol crystallises in long rhombic needles, melting at 42° C. (107·5° F.), and boiling at 182° C. (359·5° F). Its melting point is lowered by the presence of small quantities of its homologues (cresols, &c.) as well as of naphthalene, or water; indeed, a few drops of water suffice to liquefy a large quantity of phenol. With water it forms a hydrate ($2C_6H_6O + H_2O$), which solidifies on cooling to crystals melting at 17° C. (62·5° F.). The sp. gr. of liquid phenol is 1·056 at 46° C. (115° F.). Phenol has a peculiar smell, and a burning, caustic taste, it is soluble at the ordinary temperature in 13 parts of water, and its solubility increases with rise of temperature, so that at 84° C. (183° F.) it mixes well with water in all proportions. It is readily soluble in the fatty oils and glycerine, and dissolves in alcohol and ether in all proportions. Liquefied by the addition of 10% water it forms *Acidum Carbolicum Liquefactum*, B. P., and a solution in 6 parts of glycerine is *Glycerinum Acidi Carbolici*, B. P. It acts on the skin as a powerful caustic, it coagulates albumen, and precipitates solutions of gelatine. Taken internally it is a violent poison; a few drops kill a dog, and plants expire in a dilute aqueous solution. As an antidote olive or almond oil has been recommended, and also sucrate of lime, prepared by adding 5 parts of slaked lime to 16 parts of sugar dissolved in 40 parts of water, digesting the solution for 3 days, filtering and evaporating it, and drying the residue at 100° C. (212° F.).

Uses. It is used as an antiseptic, mixed with water, glycerine, or olive oil; a dilute aqueous solution is used as a spray in surgical operations (Lister's dressing). The antiseptic is sometimes required in a solid form, and it is then mixed with clay, chalk, sawdust, &c. McDougall's disinfecting powder is a mixture of calcium carbolate and magnesium sulphite. Carbolic acid, unlike creosote, when used to preserve meat imparts to it a strong, unpleasant taste. A considerable quantity is now used for the manufacture of salicylic acid, and of various colouring matters, such as picric acid, aurin, azo-colours, &c.

The extraordinary antiseptic properties of carbolic acid have long been known, but its extended use has been delayed, owing to the difficulty experienced in obtaining it in considerable quantities. It is now, however, principally owing to the labours of the late Dr F. Crace Calvert, produced on a large scale, and this chemist has proposed its application to many valuable purposes. As a medical agent it seems to have all the useful properties of creosote in an exalted degree, with some peculiar actions of its own, and has been applied with marked success in cases of chronic diarrhœa, obstinate vomiting (even after creosote has failed), and as a disinfecting wash for ill-conditioned ulcers and gangrenous sores. It has been said to have been used with marked success when inhaled as a remedy for whooping-cough. It has also been applied successfully in cases of foot-rot, a disease which annually carries off large numbers of sheep. It has been employed for the preservation of gelatin solutions and preparations of size made with starch, flour, and similar materials, and of skins and other animal substances. It appears to act strongly as an antiferment, and Dr Calvert states that it is one of the most powerful preventives of putrefaction with which he is acquainted. Commercial creosote is frequently nothing more than hydrated carbolic acid.

Professor Lister, of Edinburgh, adopting the germ-theory of putrefaction, and regarding the

putrid discharge from wounds as the result of the presence of atmospheric organisms which find a suitable nidus in the decomposing animal tissue exposed by the wound, seeks to exclude the access of these germs by the use of antiseptics, particularly of carbolic acid, the destructive action of which on living organisms is well known. He applies to the wounds dressings of gauze previously prepared with carbolic acid, additionally using as a lotion the acid well diluted with water; whilst during the dressing of the wounds and the performance of surgical operations carbolic acid is diffused in the form of spray into the surrounding atmosphere with the object of destroying the germs floating in it. See DISINFECTANTS and DRESSINGS.

Tests. (1) Phenol gives a violet coloration with ferric chloride solution. (2) When ammonia and then a solution of bleaching powder are added to an aqueous solution of phenol, a blue coloration is produced. (3) On adding bromine water to an aqueous solution of phenol a yellowish-white precipitate is obtained, which is permanent only when an excess of bromine has been added.

As several varieties of carbolic acid are found in commerce it is well to describe their main characteristics.

Absolute Phenol. Distinct short crystals of good odour and pungent taste, soluble in 13 parts water.

No. 1 *Carbolic Acid.* In compact masses of acicular crystals, having properties similar to absolute phenol.

No. 2 *Carbolic Acid.* Compact masses of crystals, soluble in about 18 parts water, odour not so mild as the first two.

No. 4 *Carbolic Acid.* A liquid containing 20% carbolic acid and 80% cresylic acid, either colourless or straw-coloured; sparingly soluble in water. Used for disinfecting sinks, drains, and water-closets.

CARBOLIC ACID GAUZE. Unbleached open-wove cotton gauze, medicated by immersion in a melted mixture of 1 part carbolic acid, 4 parts resin, 4 parts paraffin.

CARBOLIC OIL. Carbolic acid in crystals, 1 part; olive oil, 9 parts.

CARBOLISED COTTON. Cotton charged with 6% carbolic acid.

CARBOLISED SILK LIGATURES. Carbolic crystals, 1; yellow wax, 9; melt them together, pass the silk through the melted solution, then draw through a cloth to remove the excess of wax.

CARBOLISED SMELLING SALTS. Absolute phenol, 24; carbonate of ammonium, 16; strong solution of ammonia, 16; oil of lavender, 1½; camphor, 3; fine sawdust, a sufficiency to absorb the liquids. Used as an inhalation for influenza and hay fever.

CARBON. C. Atomic weight = 12. *Syn.* CARBO, L.; CHARBON, Fr.; KOHLENSTOFF, Ger. A non-metallic element belonging to the same group as silicon, titanium, tin, lead, and some other rare elements. Of these it most resembles silicon and titanium.

Source. Carbon is found native in two distinct crystalline modifications: the diamond, and graphite or plumbago. It also occurs in an amorphous form, mixed with more or less hydrogen, oxygen, and nitrogen, as coal, peat, lignite, &c.; and in combination with hydrogen and oxygen, and often with nitrogen as well, it forms the material of all vegetable and animal substances. Combined with hydrogen it is found as petroleum, and its compound with oxygen, carbonic acid, occurs free in the atmosphere and in many springs, and in combination in many carbonates, such as limestone, marble, chalk, and dolomite. Charcoal, lamp-black, and coke are more or less impure forms of carbon. For information regarding the different varieties of carbon, see the special variety in question.

Prep. Chemically pure carbon is prepared by heating pure white sugar in a platinum basin, and purifying the carbon thus obtained by igniting it in a current of pure chlorine.

Prop. In addition to the different physical properties mentioned above, we may remark that carbon has a great tendency to unite with oxygen at a high temperature. In consequence of this property, and also on account of its cheapness, it is largely used in metallurgy to 'reduce' metals from their ores, *i. e.* to take away the oxygen with which the metal is combined.

Carbon, Chlorides of. These are four in number, namely, hexachlorobenzene (C_6Cl_6), tetrachlorethylene or carbon protochloride (C_2Cl_4), hexachlorethane or carbon sesquichloride (C_2Cl_6), and tetrachloromethane or carbon tetrachloride (CCl_4). Chloroform (which *see*) is a compound of carbon with chlorine and hydrogen. Of the four chlorides we shall describe only the

Tetrachloride (CCl_4). This may be prepared by passing a mixture of carbon disulphide and chloroform through a porcelain tube filled with pieces of porcelain heated to redness. It is best made by acting with chlorine gas on boiling sulphide of carbon containing some antimony pentachloride, which serves as a carrier of chlorine. The liquid is then distilled, and the portion boiling under 100° C. (212° F.) separated and treated with boiling caustic potash in order to remove chloride of silver, trichloride of antimony, and undecomposed carbon disulphide, and again distilled. Tetrachloromethane is also formed when chloroform is heated with chloride of iodine to 160°—170° C. (320°—340° F.).

Tetrachloride of carbon is a colourless liquid, having a sp. gr. 1·6, and boiling at 78° C. (172 F.). It is insoluble in water, but dissolves in alcohol and ether. Its vapour, diluted with air, is employed as an anæsthetic.

Carbon, Oxides of. There are two of these, carbon oxide (CO) and carbonic anhydride (CO_2) (which *see*).

Carbon, Oxychloride of. $COCl_2$. *Syn.* CARBONYL CHLORIDE, CHLOROCARBONIC ACID, PHOSGENE GAS. *Prep.* Carbon monoxide and chlorine are simultaneously passed at about the same rate into a large glass balloon having a capacity of about 10 litres (2 galls.); from this balloon the mixed gases pass into a second one, which, like the first, is exposed to sunlight. It is best to employ a slight excess of chlorine, this being afterwards got rid of by passing the gas through a tube filled with lumps of metallic antimony. The gas thus purified can be liquefied by passing it into a tube surrounded by ice, or better by a freezing

mixture. Chlorocarbonic acid has a peculiar pungent smell, and fumes strongly when exposed to moist air, the moisture of which it decomposes, producing at the same time hydrochloric and carbonic acids. It is sometimes employed in chemical research for the removal of hydrogen from organic compounds, and the substitution of carbonic oxide, or its elements, for the hydrogen.

Sulphides. Only one is known, namely—

Carbon Bisulphide or Disulphide, CS_2. *Syn.* SULPHIDE DE CARBONE, Fr.; SCHWEFELKOHLENSTOFF, Ger. *Prep.* This body may be made on the small scale by passing sulphur vapour over fragments of charcoal heated to redness in a porcelain or iron tube. The experiment is, however, both tedious and dangerous, and is never employed now, as carbon bisulphide is made on a very large scale.

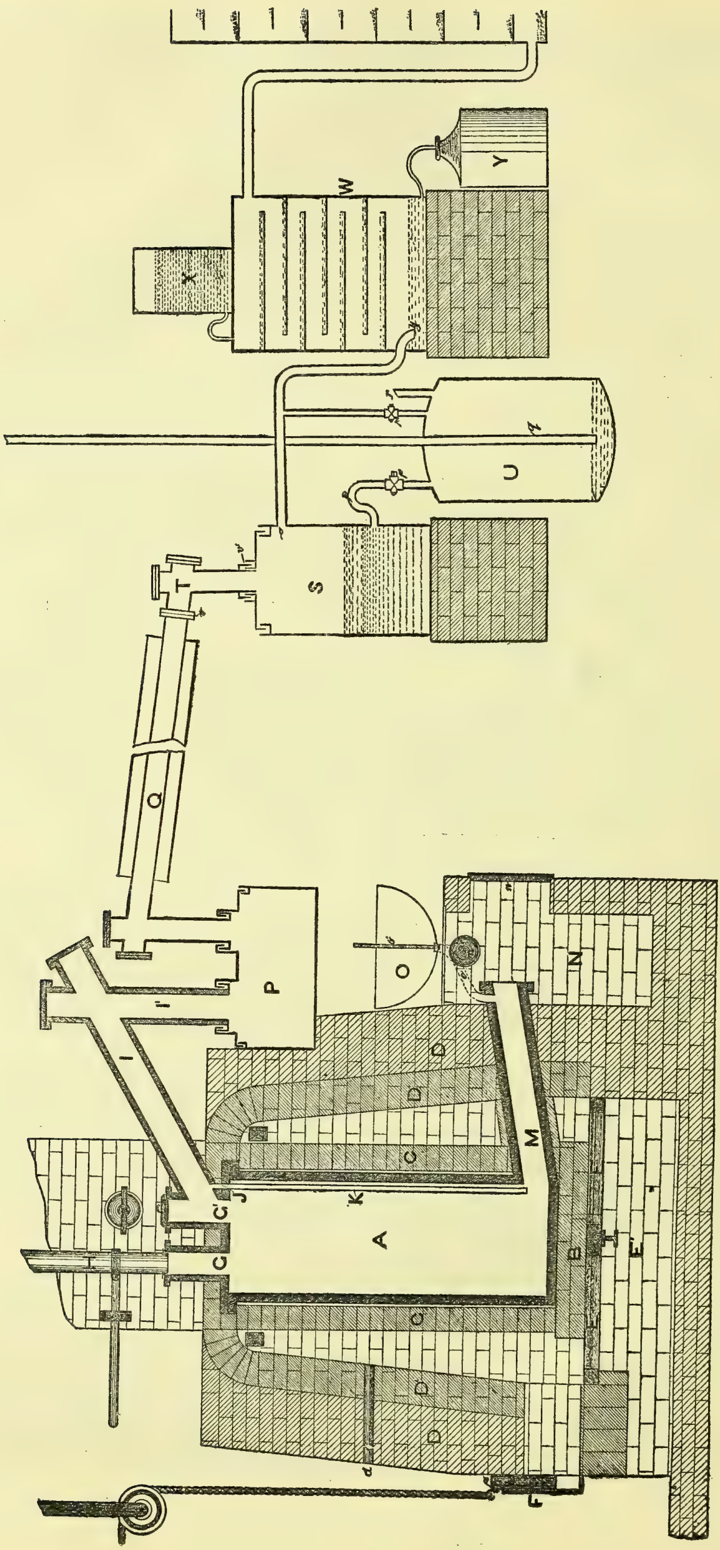
On the large scale it is made by passing sulphur vapour up through charcoal heated to redness in a vertical retort of porcelain or cast iron, and condensing the product of the reaction. In the old (Peroncel) process, introduced 40 years ago, coke was employed, and heated in metal cylinders which were coated externally with fire-clay, and had their lower halves surrounded by the burning fuel. The sulphur was introduced into the retort at the top, and to do this the lid of the retort had to be removed every few minutes, occasioning a great loss of carbon bisulphide. The cylinder lasted about a week, and when made about 6 ft. long by 1 ft. diameter produced about 2 cwt. of carbon bisulphide per day. This is the process described in all the text-books, but it is an antiquated one, and is now superseded by more recent ones, by means of which the bisulphide is manufactured at the cost of about 1*d.* per lb. Charcoal is used instead of coke, and with an elliptical retort 66 in. high, and 20 in. by 12 in. internal section, 4 to 5 cwt. of carbon bisulphide can be made per day, and the retort lasts at least 60 days. The bisulphide is thus produced at about $\frac{1}{17}$ of its cost by the old method. The following figure and description of the modern apparatus are taken from a paper by Mr I. Singer in the 'Journal of the Society of Chemical Industry,' vol. viii, p. 93 (1889); this paper should be consulted if more detailed information is required.

A is the generator, which contains the charcoal. It is a vertical retort of elliptical section, made of cast-iron, or better of earthenware glazed inside. It is surrounded by a layer of fire-brick, *C*, and another layer of fire-brick, *D′*, lines the inside of the furnace. *E′* is an ash-pit, *E* a fire-grate upon which a thin layer of fuel is burnt, so that the products of combustion circulate round the retort and heat it to an even temperature. The retort is kept at a cherry-red heat, its temperature being observed through the peep-hole, *d*. The charcoal is fed in every 8 hours through the tubulus, *G′*; while this is being done the vent-pipe, *H*, is lowered through the tubulus, *G*, so as to carry off the noxious gases, and prevent them from injuring the workmen. The charcoal is introduced hot from a small retort, about 1-3rd the size of *A*, set horizontally above the latter, and heated by the waste gases of the furnace; the charcoal may even be made advantageously in this retort from spent dye-woods, sawdust, &c., the products of distillation being collected. The sulphur is melted in the iron vessel, *O*, which is heated by a flue from the furnace. It is admitted into the bottom of *A* through the tube, *M*, by raising the valve, *o′*. Its vapour passes up through the red-hot charcoal, and combines with it, forming carbon bisulphide. This passes off through the tube, *I*, where uncombined sulphur is deposited and runs down through the tube, *K*, to the bottom of the retort. The bisulphide vapour then passes through the vessel, *P*, where any remaining sulphur is deposited, and then through the Liebig's condenser, *Q*, where it is condensed, and runs into the vessel, *S*, and from this into the vessel, *U*. From this vessel it is from time to time forced up through *q* into a reservoir by closing the stopcocks, p^1 and p^2, attached to *U*, and pumping in air under pressure through *r*. The remaining gases pass through the scrubber, *W*, where any bisulphide vapour is absorbed by a vegetable oil contained in narrow trays, and finally through the scrubber, *Z*, containing lime or oxide of iron, where sulphuretted hydrogen is absorbed.

The crude product thus obtained is of a pale yellow colour, being impure from the presence of sulphur, sulphuretted hydrogen, and other substances. It is purified by careful rectification, but the commercial bisulphide is seldom quite pure. A very pure product may be obtained by forcing lime-water in fine jets through the bisulphide till it runs off colourless, and then adding to the bisulphide about 1% of its weight of a cheap colourless oil, covering the whole with a layer of water about an inch in depth, to which some sugar of lead may be added, and finally distilling off the carbon bisulphide.

Prop. When pure it is a colourless, highly refractive liquid with a faint ethereal odour, boiling at 46° C. (115° F.), and of sp. gr. 1·29 at 0° C. (32° F.). It undergoes a slight decomposition when kept, and indeed the commercial variety is always more or less impure, and possesses a most pungent and disgusting odour. It dissolves sulphur and phosphorus and many fatty bodies; sulphur crystallises out from solution in carbon bisulphide in splendid octahedra. It does not solidify except at a very low temperature. It is a very volatile liquid, and if placed in the vacuum of an air-pump its temperature falls to −63° C. (−81° F.). By evaporating a mixture of carbonic disulphide and solid carbonic acid *in vacuo* an extremely low temperature can be obtained. Carbon bisulphide is a very inflammable gas, and very dangerous when it explodes, as it combines with the oxygen of the air, forming sulphur dioxide and carbonic acids, and leaves the nitrogen, thus forming three irrespirable gases. The physiological effects of the vapour, when inhaled, are very deleterious.

Uses. The following are among the more important: 1. For the extraction of fats and oils from seeds, &c. 2. For the extraction and recovery of oils and fats from bones, stearine-waste, dried axle-grease, the pressings (greaves) from tallow, sanza (the husks of the olives after leaving the presses), and a large number of other waste products. 3. Also from rags and cotton waste, leaving both oil and rags in a fit state for



re-use. 4. For cleaning wool and recovering the fat from it. 5. As a solvent for chloride of sulphur in vulcanising caoutchouc and in 'waterproofing.' 6. For the extraction of sulphur from poor ores, which were formerly thrown away as being too expensive to extract by the old process. 7. For the recovery of grease from soapsuds in wool-washing. 8. For killing weevils in grain (a small quantity mixed with the grain in a closed chamber is said to kill even the larvæ). 9. In Australia for killing rabbits. 10. As an emulsion with water (which is easily made by the addition of a little sulpho-ricinoleate), for killing parasites on plants, especially in France and Germany to destroy the *phylloxera*. 11. In electro-gilding, as a solvent for phosphorus. 12. In hollow glass prisms, on account of its great refracting power.

Of late it has been proposed for use in steam boilers instead of water, and several devices have been patented for the purpose.

It is also useful for producing low temperatures, and as an antiseptic. For information regarding its antiseptic properties papers by Zöller ('Berichte der deutschen chemischen Gesellschaft,' 9, 707 and 1080) and by Schiff (*ibid.*, p. 828) may be consulted.

CARBONATE. A compound of carbonic anhydride (CO_2) with a metallic oxide; or it may be regarded as a salt of the hypothetical carbonic acid (H_2CO_3).

Sources. The carbonates occur very abundantly in nature. Calcium carbonate occurs as *calcite, marble, chalk,* and *limestone;* magnesium carbonate occurs as *magnesite,* and together with calcium carbonate as *dolomite;* strontium carbonate occurs as *strontianite,* and barium carbonate as *witherite.* Zinc carbonate, or *calamine,* and ferrous carbonate, or *spathic iron ore,* are important ores of zinc and iron.

Prep. Most carbonates being insoluble in water, they may be prepared by double decomposition by adding a solution of sodium carbonate to a solution of a soluble salt of the metal. The processes by which particular carbonates are prepared will be found described under the respective metals.

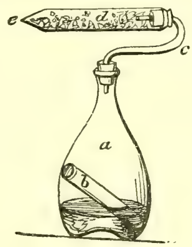
Prop. The carbonates of the alkali metals are soluble in water. The other carbonates are white bodies insoluble in water, but dissolving to some extent in water charged with carbonic anhydride; on boiling the solution thus obtained, the carbonic anhydride is driven off and the carbonate precipitated.

Tests. The carbonates are easily distinguished by the following reactions: They dissolve with effervescence in hydrochloric acid and in most other acids; in some cases a gentle heat is required to promote the disengagement of the gas. The gas evolved in the last, passed into lime water and baryta water, occasions white precipitates, which redissolve in acids with effervescence, and after the solution has been boiled are not reprecipitated by liquor of ammonia. Chloride of calcium and chloride of barium give white precipitates in solutions of the neutral alkaline carbonates, but in solutions of the alkaline bicarbonates only after ebullition; and the precipitates are readily soluble with effervescence in acetic acid.

Estim. The quantity of metal in a carbonate may be determined by one of the methods for estimating the particular metal, or more simply by the following alkalimetrical method. A weighed quantity of the carbonate is dissolved in a measured excess of standard hydrochloric acid diluted with a little water; the solution is then boiled to expel the carbonic acid, and the excess of hydrochloric acid is ascertained by running in a standard solution of soda or ammonia from a burette, till the excess of acid is neutralised. The quantity of carbonic acid is estimated by means of the apparatus figured on p. 70 (see Alkalimetry), or the somewhat simpler apparatus figured below may be used.

A weighed sample of the carbonate to be examined is placed in the flask, *a*, with a little water, and the small tube, *b*, filled with either sulphuric or hydrochloric acid, is carefully introduced. The cork, with its chloride of calcium tube, *d*, is then fitted to the flask, and the whole apparatus very accurately weighed.

On inclining the apparatus the acid escapes over the side of the small tube, and mixing with the liquor in the flask, expels the carbonic acid of the carbonate, which is then dried by passing over the chloride of calcium. After efferves-



a, Flask containing the sample of carbonate for examination, stopped by a closely fitting cork, through which passes the bent tube, *c*.
b, A small tube, sufficiently long to maintain a slanting position without falling, filled with sulphuric or hydrochloric acid.
c, A bent tube, connecting the flask with *d*.
d, Horizontal tube, filled with small fragments of fused or dried chloride of calcium, with a fine orifice at the extremity, *e*.

cence has ceased heat should be applied to the bottom of the flask, until it be filled with steam, to expel the carbonic gas it contains. The loss of weight gives the weight of the carbonic acid gas that was contained in the sample.

The quantity of carbonic acid in carbonates other than those of the alkali metals which do not contain water, may be determined by heating them to redness in a platinum crucible. The loss of weight gives the weight of carbonic anhydride they contain.

CARBON CONES. See Disinfectants.

CARBONIC ACID. H_2CO_3. True carbonic acid has not yet been obtained in any satisfactory condition, although the solution of carbonic anhydride (often called carbonic acid), or anhydrous carbonic acid, is generally regarded as such. It forms with bases an important series of salts called the carbonates, by double decomposition.

This name is also very frequently, though somewhat erroneously, applied to the oxide of carbon

CO_2, which is more properly termed carbonic anhydride.

CARBONIC ANHYDRIDE. CO_2. *Syn.* Carbonic acid, Carbon dioxide, Choke-damp; Acide carbonique, Fr.; Kohlensäure, Ger.

A compound of carbon and oxygen, containing twice as much oxygen relatively to the carbon as the monoxide.

Source. It occurs in the air, of which it forms 0·04 % by volume. The carbonic acid in the air is derived from the combustion or decay of organic matter, and forms the source from which plants derive their carbon. It issues from the earth in many places, especially in the neighbourhood of volcanoes: for example, at the Grotto del Cane, near Naples; in the Poison Valley, in Java; and near the Lake of Laach, in Germany.

It occurs in solution in all natural waters, giving them their pleasant sharp taste; the waters of many mineral springs contain large quantities of it, and when they issue from the well the excess of the gas escapes with effervescence. It also occurs as 'choke-damp,' or 'after-damp' of the miners, and it is evolved in the formation of alcohol by the fermentation of sugar, as in brewing, &c. It is exhaled by all animals in the process of respiration, and by plants also in the nighttime. Combined with bases as carbonates it occurs largely as a constituent of the earth's crust. See Carbonates, Respiration.

Prep. 1. By treating marble, chalk, carbonate of soda, &c., with dilute hydrochloric acid. 2. It may be obtained mixed with nitrogen by aspirating air through a tube packed with red-hot charcoal.

The gas may be collected over water in the pneumatic trough, though with some loss, as it is slightly soluble in water. If required dry it must be led through a tube containing fragments of fused calcium chloride, or bubbled through strong sulphuric acid, and then collected over mercury.

On the large scale it is prepared by heating limestone, and is thus obtained as a by-product in the manufacture of quicklime. It is also sometimes obtained by the combustion of charcoal or coke.

Prop., Uses, &c. Carbonic anhydride is a colourless gas possessing a slightly pungent odour and a faintly acid taste. It is more than $1\frac{1}{2}$ times as heavy as air (sp. gr. = 1·524), and may consequently be poured from one vessel to another like water. It may be liquefied by a pressure of 36 atmospheres at a temperature of 0° C. (32° F.), and at lower temperatures by smaller pressures. If the liquid is allowed to evaporate, it is cooled so much by evaporation that it solidifies. The solid melts at −65° C. (−85° F.); when mixed with ether and placed in the vacuum of an air-pump, a very low temperature is produced (−110° C. = −162° F.). Water absorbs its own volume of the gas, whatever the pressure of the latter may be; the solution faintly reddens blue litmus paper.

Carbonic acid will not support combustion; a lighted candle placed in it immediately goes out. It is also incapable of supporting life when breathed, but seems to have no direct poisonous action on the system.

Carbonic acid is used in the manufacture of aërated waters. It is forced into the water under pressure, and when the bottle is opened the excess of the gas escapes with effervescence. Soda-water is nothing but water containing carbonic acid. Other mineral waters contain small quantities of other ingredients. Carbonic acid is also used in the ammonia-soda process for the preparation of bicarbonate of soda, in the manufacture of white-lead, and lately by Mr Chance in a process which he has patented for the recovery of sulphur from alkali-waste.

Tests. It feebly reddens litmus paper, extinguishes the flame of a burning taper, and forms a white precipitate in aqueous solutions of lime and baryta, which is soluble in acetic acid. By the last test a very small quantity of this gas may be easily detected in the atmosphere of rooms, &c. A lighted candle is generally used to test an atmosphere suspected to contain carbonic acid; but it is found that air that will support combustion will contain sufficient of this gas to cause insensibility.

Poisoning by Carbonic Acid. The patient should be immediately removed into the open air, and placed on his back with the head slightly raised. Cold water should be dashed over the body, hot water or mustard poultices applied to the feet, and ammonia (carefully) to the nostrils. Brandy-and-water and other stimulants may be administered. Continued friction of the body is also very useful. If the patient has ceased to breathe, artificial respiration should be attempted. This may be done by gently pressing down the ribs, and forcing up the diaphragm, and then suddenly withdrawing the pressure. The inhalation of air, mixed with very little chlorine gas, has been also recommended. Wells, cellars, or other underground apartments containing carbonic acid in poisonous quantities, may be freed from this gas by pumping it out in the same way as water, taking care that the suction hose fully reaches the floor or bottom of the place. Fresh slaked lime, or milk of lime copiously thrown in will have a like effect by absorbing the gas. Free ventilation, whenever it can be established, is, however, not only the cheapest, but the most efficient remedy.

CARBON'IC OXIDE. CO. *Syn.* Protoxide of carbon, Carbon monoxide; Oxy'dum carbon'icum, L. A compound of carbon and oxygen, containing half as much oxygen relatively to the carbon as carbonic anhydride.

Prep. 1. From carbonic acid gas passed over fragments of charcoal, heated to redness in a tube of porcelain or iron.

2. From crystallised oxalic acid, gently heated with 5 or 6 times its weight of strong sulphuric acid in a glass retort.

3. From ferrocyanide of potassium in fine powder, and 8 or 10 times its weight of concentrated sulphuric acid, heated together in a glass retort.

Obs. All the processes except the last give a mixture of carbonic acid and oxide. It is therefore necessary to pass the gas through a caustic alkaline solution or milk of lime to deprive it of carbonic acid. It may then be passed over dried chloride of calcium, to deprive it of moisture. It may be collected either over mercury or water, as the latter absorbs very little of this gas.

Prop. Carbonic oxide is a colourless, inodorous, neutral, inflammable, and irrespirable gas. It burns with a pale blue flame, uniting with oxygen to form carbonic anhydride. It is extremely poisonous, 1% mixed with air being sufficient to cause dangerous drowsiness. The deaths produced by the combustion of charcoal in close rooms are attributable to this gas. It combines with the hæmaglobin of the blood, forming a stable compound which prevents the hæmaglobin fulfilling its function as a carrier of oxygen; the blood acquires a light purple-red colour. The hæmaglobin compound gives a characteristic absrption spectrum, which is of great service in detecting cases of poisoning by carbonic monoxide. The antidotes, &c., are the same as for poisoning from inhaling carbonic acid.

CAR'BUNCLE. *Syn.* ANTHRAX; ANTHRAX, Fr.; KARBONKEL, Ger. *Def.* "A specific local inflammation of the subcutaneous areolar tissue, rapidly leading to sloughing of the deeper and more central parts, followed by destruction of the skin; the whole of the dead tissues finally separating in the form of a slough" (*Dr W. Meredith*).

Carbuncle is a constitutional affection depending upon a condition of general debility, and often associated with gout and diabetes. When it occurs near the neck or scalp it is often a very serious malady, especially in persons past middle life. The local treatment is similar to that for boils and abscesses, but this must be combined with general attention to the health of the patient —good, easily assimilable food, the cautious use of stimulants, tonics, &c.

CAR'BURETTED HY'DROGEN. See HYDROGEN.

CARD'AMOM. *Syn.* CARD'AMUM; CARDAMO'MUM, B. P. The seed or fruit of the *Elettaria Cardamomum* forms the officinal cardamom. It is warm, pungent, carminative, and stomachic, and is largely used as a condiment in the East, and in Europe as an adjuvant in other medicines. Several kinds of cardamoms used medicinally and as spices are produced by the genus *Amomum*, belonging to the Nat. Ord. ZINGIBERACEÆ, the Ginger family. A tincture is contained in the B. P.

CARD'BOARD. Cardboard, or sized pasteboard, is made of 2 to 15 sheets of sized paper, pressed and stained. There are varieties of cardboard known as Bristol-board, London-board, the former being largely used for water-colour drawings, mounting-board, ornamental board, &c.

Enamel for. Take 1 *lb.* parchment cuttings, ¼ *lb.* isinglass, ¼ *lb.* gum arabic, and boil together in an iron pot in 4 galls. of water until the whole is reduced to about 12 quarts; then remove from the fire and strain; now divide into 3 separate quantities of 4 quarts each; to No. 1 add 6 *lbs.* white-lead ground fine in water; to No. 2, 8 *lbs.* white-lead; and to No. 3, 6 *lbs.*; stretch the paper or cardboard on a flat board, and lay on a thin even coat of No. 1; then dry for 24 hours; then coat in the same way with No. 2, and dry as before; lastly, coat with No. 3 and dry again; the gloss is obtained by passing the prepared board between highly polished steel rollers.

CARMIN'ATIVES. Medicines that allay flatulency and spasmodic pains. Among the principal carminatives are ANISEED, CARAWAY SEED, CARDAMOMS, CASSIA, CINNAMON, GINGER, PEPPERMINT, and the PEPPERS. To these may be added ARDENT SPIRITS, and most of the AROMATIC ESSENCES and TINCTURES. See MIXTURES, PATENT MEDICINES, &c.

CAR'MINE. *Syn.* CARMINE RED, VEGETABLE SCARLET; CARMI'NUM, L. A beautiful red pigment prepared from the cochineal insect.

Prep. The preparation of carmine is little understood, but success in its manufacture depends less on any mystery connected with the process than on the employment of the purest water and the best materials, and the exercise of moderate care, dexterity, and patience. The following formulæ will produce carmine of the richest hues down to ordinary and common, according to the skill possessed by the manipulator.

1. (*Madame Cenette's Process.*) Cochineal (in powder), 2 lbs., is boiled in pure river water, 15 galls., for 2 hours, when refined saltpetre (bruised), 3 oz. is added to the decoction, and the whole boiled for 3 or 4 minutes longer; salt of sorrel, 4 oz., is next added, and the boiling again renewed for 10 or 12 minutes; the heat is now removed, and the liquid allowed to settle for about 4 hours, after which time it is decanted with a syphon into shallow plate-like vessels, and set aside for 3 weeks. At the end of this time the film of mould which has formed on the surface is dexterously and carefully removed, without breaking it or disturbing the liquid beneath it. The remaining fluid is next very carefully removed with a syphon, and the adhering moisture, as far as possible, drained off, or sucked up with a pipette. The residuum, which is the carmine, is dried in the shade, and possesses extraordinary lustre and beauty.

2. (*Alxon or Langlois' Process.*) Powdered cochineal, 1 lb., is boiled in river water, 4 galls., for 10 minutes, when carbonate of soda, ¾ oz., dissolved in water, 1 pint, is added, and the whole again boiled for ½ hour longer; when the decoction is cold, alum (in fine powder), ¾ oz., is thrown in, and the liquid agitated rapidly until it is entirely dissolved; after 20 minutes' repose it is decanted into another vessel, and clarified by heating it with the whites of 2 eggs; the perfectly clear liquid is then allowed to repose for 40 minutes or longer, when it is decanted, and the carmine which it has deposited is collected, drained on a filter, and dried on shallow plates covered with silver paper. The product by either of the above processes varies from 9½% to 10% on the weight of the cochineal employed in them.

3. (*China or Spirit Process.*) Cochineal, 1 lb., is boiled for 15 minutes, in water, 3 galls.; powdered alum, 1 dr., is next added, and the whole again boiled for 5 or 6 minutes; when the liquid has become cold, the clear portion is decanted and again heated, the solution of tin (spirits of tin) cautiously dropped in until all the carmine is precipitated; it is collected, drained, and dried as before.—*Prod.* 1½ oz.

3. (*French Process.*) From cochineal (in powder), 1 lb., boiled for 15 minutes, in water, 3 galls.; cream of tartar (in powder), 1 oz., is then added, the boiling further continued for 10

minutes, and powdered alum, 1½ oz., thrown in; after another 2 minutes' boil the heat is withdrawn, and in 5 or 6 minutes more the clear portion is decanted into porcelain vessels, which are set aside until the carmine falls down.

4. (*German Process.*) Powdered cochineal, 1 lb., water, 4 galls.; boil 15 minutes, add powdered alum, 1 oz.; boil 3 minutes longer, remove the heat, allow the liquor to settle for 5 minutes, pour off the clear portion into porcelain or earthenware vessels, and set them aside for 3 or 4 days. The carmine is found deposited on the bottom of the vessel, and must be now carefully drained and dried, as before. The decanted liquor yields more carmine by standing in fresh vessels. —*Prod.* About 1½ oz.; besides ½ oz., or more, of an inferior quality obtained as a second deposit.

5. (*English Process.*) From cochineal, 1 lb., and carbonate of potash, ⅛ oz., boiled in water, 7 galls., for 15 minutes; the vessel is then removed from the fire, and powdered alum, 1 oz., added; the liquor is then well agitated and allowed to settle for about 15 minutes longer; the clear liquid is next decanted into a clean copper, and isinglass, ⅛ oz., dissolved in water, 1 pint (and strained), added; as soon as a coagulum forms upon the surface the heat is removed, and the liquid is strongly agitated with a bone or silver spatula, after which it is allowed to repose for 20 or 30 minutes. The deposited carmine must be drained and dried as before.

Obs. The best black cochineal is generally used for the preparation of carmine. For ordinary qualities spirits of tin (bichloride) is added to the decoction as a precipitant, and the liquid being put into suitable vessels (wash-hand basins answer very well), a deposit of carmine slowly takes place. Neither exposure to solar light nor artificial heat is advisable during the drying, but the latter must nevertheless be effected with all possible expedition. Hence the finer shades of carmine can only be successfully made during certain states of weather; as in very hot weather the liquid rapidly sours or ferments, and the deposit is more or less dissolved; whilst in dull, damp weather it is difficult to dry the precipitate sufficiently, which is then apt to become mouldy, and to lose colour. The researches of Pelletier and Caventou tend to show that the solution of tin used as a precipitant should be at the maximum of oxidation or chlorination, to produce the richest shades of carmine. That first deposited is, in all cases, the most beautiful, and the quality gradually deteriorates as the process proceeds. 6 or 7 dr. only of carmine of the very finest quality can hence be obtained from 1 lb. of cochineal.

M. Dechan comes to the conclusion that carmine is not a true chemical compound, but a mixture of several compounds. Experiments, instituted for the purpose of determining whether carmine could be prepared without the use of alum or tin spirits, have very clearly established the fact that one of the bases, aluminium or tin, is necessary for its production.

The composition of carmine is variable, and this, the author considers, is due to the fact that the union between the alumina and colouring matter is of a physico-chemical nature, and that, consequently, carmine need not be expected to possess a constant chemical composition.

The following substances are mentioned as likely to be found in commercial carmine:—Vermilion, chrome red, albuminous or starchy matters, aniline carmine, and uncombined alumina and lime.

The method adopted in the examination of 10 samples was as follows:—The quantity taken for analysis was 0·2 grm. This was digested in dilute ammonia, with frequent stirring, for 20 minutes, then poured on a tarred filter and washed with ammonia until all traces of carmine had disappeared. The filter was dried at 100° C., and weighed, and the percentage of matter insoluble in ammonia calculated. The residue on the filter was now washed with dilute hydrochloric acid and distilled water, again dried and weighed. In the absence of chrome red the loss in weight was calculated as uncombined alumina and lime. The substance left on the filter after washing with hydrochloric acid was ignited, and the loss calculated as albuminous and starchy matters. If vermilion was present the mercury was determined by a combustion analysis, and the proportion of sulphide to the other substances calculated. In all cases the ash of the whole substance was determined as well as the ash of the insoluble residue.

The test for the presence of aniline carmine consists in dyeing a piece of white woollen cloth in the ammoniacal filtrate and comparing tint of colour produced. If the ash of the whole substance shows the absence of oxide of tin, aniline carmine need not be looked for.

Prop., &c. Pure carmine is a very light, lustrous, scarlet powder, entirely soluble in ammonia, a test by which its purity is readily determined. Mr Warren De la Rue says the pure colouring principle of cochineal is carminic acid. By digesting ammonia on carmine until all the colour is taken up, filtering and adding acetic acid and alcohol till the whole is precipitated; and lastly, carefully washing the precipitate with spirit of wine, at proof, and drying in the shade, carmine of the richest and most lustrous hue may be obtained even from samples of inferior quality.

Uses, &c. As a pigment in velvet and miniature painting, and for tinting artificial flowers, and as rouge for the complexion. The powdered cochineal (carmine grounds), from which the coloured liquor (liquid rouge, carmine liquor) has been decanted, is used by the paper-stainers, and both are used in the preparation of carminated lake.

Carmine, Blue. See INDIGO.

Carmine, Li'quid. *Syn.* FLUID CARMINE, LIQUID ROUGE, CARMINE INK. *Prep.* 1. A solution of carmine in ammonia water, or spirits of hartshorn. Very rich and beautiful.

2. The residual liquor of the process of making carmine. Inferior. The first is used in velvet and miniature painting, and for tinting artificial flowers; the second for common purposes, as a stain or wash.

Carmine, Pur'ple. See MUREXIDE.

CARMIN'IC ACID. $C_{14}H_{14}O_8$. *Prep.* (*W. De la Rue.*) The powdered insect after treatment with ether to remove the fat, is digested in water. The decoction of cochineal is preci-

pitated by adding a solution of acetate of lead, and the impure carminate of lead thus formed, after being washed with water, is suspended in water, and decomposed by a stream of sulphuretted hydrogen; the whole process is repeated with the decanted solution so obtained; the second solution is then evaporated to dryness (*in vacuo* over sulphuric acid), dissolved in absolute alcohol, digested on some washed crude carminate of lead (to separate a little phosphoric acid), and, lastly, mixed with ether (to precipitate some nitrogenised matter), the residuum obtained by careful evaporation (*in vacuo*), is pure carminic acid.

Prop., &c. A purple-brown mass, yielding a rich red powder; it is freely soluble in water and alcohol; slightly soluble in ether; and without decomposition in oil of vitriol; it is feebly acid; its salts are termed carminates, only two or three of which have been examined. According to Mr De la Rue, this acid constitutes the pure colouring matter of cochineal.

CARNAUBA ROOT. The root of the *Corypha cerifera*, a wax-bearing palm, growing on the shores of the Rio Francisco, in Brazil. Dr C. Symes (see 'Pharmaceutical Journal,' 3rd series, v, 661) says: Two bales of this root have been imported into Liverpool, with the following remarks in Portuguese:—"This root is recognised by the professor as an excellent purifying agent, and has been successfully applied in the cure of various diseases arising from impurity of the blood. We are indeed astonished that it is not more widely known, as its therapeutic qualities, which are worthy of full credence, rival those of sarsaparilla. The carnauba root likewise has a diuretic power, and possesses unusual efficacy, in the cure of acute and chronic blennorrhœas. It is, furthermore, very cooling, and displays a vigorous action in purifying the blood." Mr Cleaver, who submitted the root to analysis, found it to contain very minute quantities of an alkaloid, an acrid resinous body, a red colouring matter, a variety of tannic acid, and a small portion of volatile oil.

CAROBA. The leaves of *Jacaranda lancifoliata*, *J. procera*, *J. tomentosa*, belonging to the family *Bignoniaceæ*, employed in Brazil as a diaphoretic, diuretic, and alterative tonic. Dr Alt states that he has used them extensively, and with much success, in old-standing cases of syphilitic eruptions, and after a course of mercurial treatment. They are usually administered either in the form of powder or decoction. An extract of caroba is known as salud.

CAROT'INE. $C_{18}H_{24}O$. A crystalline, copper-red substance, obtained from the root of the *Daucus carota* (*sativa*), or garden carrot. It is tasteless; odourless; neutral; fusible; inflammable; insoluble in ether and water; slightly soluble in alcohol; and very soluble in the fixed and volatile oils.

CAR'PETS. Consideration of cleanliness and economy demand a few words on carpets and hearth-rugs. Before proceeding to sweep a carpet, a few handfuls of waste tea-leaves should be sprinkled over it (say some 5 or 6 minutes before). The wet leaves take up the dust and prevent its rising in the air and subsequently settling on the furniture. A stiff hair-broom or hair-brush only should be employed, unless the carpet be very dirty, when a whisk or carpet-broom may be used first, followed by another made of hair to take off the loose dust. The frequent use of a stiff 'carpet-broom' (those made of cane or birch are here alluded to) soon wears off the beauty of the best carpet. An ordinary clothes-brush, or a clean one, resembling the dirt-brush used for shoes, is best adapted for superior carpets. When carpets are very dirty they should be cleaned by shaking and beating. "If you must have a carpet, take it up two or three times a year, instead of once. A dirty carpet literally infects the room: if you consider the enormous quantity of organic matter from the feet of people coming in, which must saturate it, this is by no means surprising" (*Miss Nightingale*). In laying down carpets it is very advisable, at first, to cover the floor beneath them with large sheets of thick paper, so as to prevent the dust from rising between the boards. Old drugget, sacking, matting, or any similar substance, will effect the same purpose, and will, moreover, materially increase the durability of the carpet by preserving it from contact with the hard floor. The condition of the floor is of great consequence to the preservation of carpets. Rough, uneven boards, especially warped boards, present elevations which, receiving the largest amount of pressure, soon begin to show on the carpet as bare patches or lines. The use of thick paper, or sacking, under a carpet is especially advisable under these circumstances.

BRUSSELS CARPETS may be cleaned with ox-gall (1 pint to a pailful of water), and a scrubbing-brush, and floor-cloth; afterwards rinsing them in fresh water applied in the same way. They should be previously perfectly freed from dust by beating, and should be nailed down before commencing the above operations. Great care should be taken to rub them as dry as possible with a clean dry floor-cloth. A small portion only should be done at a time, and a dry windy day selected for the purpose. A carpet treated in this manner will be greatly refreshed in colour, particularly the greens.

KIDDERMINSTER CARPETS will scarcely bear the above treatment without becoming so soft as to get speedily dirty again. This may in some measure be prevented by brushing them over with a hot weak solution of size in water, to which a little alum has been added. Curd soap, dissolved in hot water, may be used instead of ox-gall, but it is more likely to injure the colours if produced by false dyes. When there are spots of grease on the carpeting they may be covered with curd soap, dissolved in boiling water, and rubbed with a brush until the stains are removed, when they must be cleaned with warm water as before. The addition of a little gall to the soap renders it more efficacious. Some persons employ a mixture of soap, fuller's earth, and turpentine for the same purpose. Benzol rapidly removes the grease stains, and may be advantageously substituted for preparations of soap.

CARPOCAPSA POMONELLA, Westwood. The Codlin Moth. The codlin moth is a very small moth, but its larvæ or caterpillars are most destructive to the apple-crop in some seasons by burrowing into the fruit and causing it

to drop prematurely. As early as the middle of June sometimes the apples begin to drop off and continue to fall throughout the summer. Upon examination of those that have thus fallen it will be discovered that at the blossom end of the apple there is a clear sign of decay. An orifice can be detected, and if the apple is split in halves a passage will be found leading down to to the ovary, or pip- or seed-centre, in which there is a small caterpillar; or another passage leading to the outside of the apple, by which the caterpillar has evidently made its exit.

Apples which are, or which have been, thus occupied by these larvæ fall off prematurely for the most part. Those which hang and are finally picked and stored, quickly become rotten or are entirely spoilt for dessert purposes. Though it is called the codlin moth, its injurious effects are not confined to the codlin. It was probably so named because codlins and their varieties, especially the Keswick codlins, are somewhat early apples and fall off soon, and being large apples make a great show on the ground. It attacks many sorts of apples. Mr Whitehead says that he has seen it in June-eatings, in the brilliant early sort known as the Gladstone, in the golden pippin, and very frequently indeed in the king pippin. The kind of apples which have deep open eyes and very large tufts of the calyces remaining in them, like the codlin, the king pippin, the Blenheim orange, the margil, the Cox's orange pippin, and the ribston pippin, appear to be the most affected, while such apples as the nonpareil, russet, golden knob, and others whose eyes are well closed up, have comparative immunity from it.

In some seasons this insect is very abundant and troublesome. For instance, in 1877, in many of the Kentish orchards, it caused from 20% to 30% of the apples to drop off, and many of the stored apples would not keep from this cause. In the cider-making counties great losses are entailed. Quantities of immature apples lie thickly upon the grass in the early days of July, in each of which there is a maggot or signs that a maggot has been there and destroyed its kernel. After a stiff gale in the early part of the summer, the effects of this insect can be readily seen. Frequently this fall of apples is called the 'summer drop,' and is attributed to want of vigour in the tree, or to the weather. The apples are not examined, the presence of the insects is unsuspected, and the apples are left to commence a new series of destruction. Many apples also are carried into the store-rooms with the maggots in them. These make their escape and crawl into the chinks and crannies from which the moth comes forth in due time, to recommence the attack upon the nearest apple trees.

Gardeners complain bitterly of the injury occasioned by the *Carpocapsa* to their fine dessert fruit. Many say that it selects the best flavoured sorts and those of firm juicy flesh. In gardens the attack is plainly seen, as the trees are for most part bush trees or pyramids, or half standards, cordons, or espaliers, and the progress of the evil can be watched from the first trace of the dark spot in the calyces to the appearance of the larva depending from the apple by a silken cord.

The *Carpocapsa pomonella* is known as destructive to the apple crop in France and Germany. In France it is said that the moth shows a decided preference for the best fruit, and is more tiresome in the gardens of the gardeners and small cultivators than in the orchards of the Northern departments where cider is so abundantly produced. The German apple-growers, notably those who cultivate the choicer kinds, dread the ravages of this pest. Köllar in his instructive treatise states that "so long ago as 1822 more than half of the apple crop, particularly of the choicest fruit, was grub-eaten" ('Naturgeschichte der schädlichen Insekten,' von V. Köllar). American and Canadian fruit-growers find this one of the most dangerous insects which infest their orchards. Mr Saunders affirms that it was imported from Europe into America about the commencement of the present century, and confirms its evil reputation. Professor Lintner, the New York State Entomologist, also believes that the *Carpocapsa* was first brought from Europe. This moth causes infinite harm to the apple, pear, and quince crops in California, where a very large quantity of fruit is produced, and where fruit production is largely increasing year by year. Mr Matthew Cooke, the chief executive horticultural officer of the State of California, quotes the following passage from a Sacramento journal ('A Treatise on the Insects Injurious to Fruit and Fruit Trees,' by Matthew Cooke, Sacramento) :—" The codlin moth is now one of the permanent institutions of the State, and fruit growing, or at least apple growing, has been rendered very unsatisfactory and uncertain." It appears to have commenced operations in California in 1874. Communications have been received from a friend, who grows fruit near Hobart Town, in Tasmania, to the effect that the *Carpocapsa* has been known in that country for many years, and that sometimes it destroys and spoils many apples. From Victoria, in which colony apple growing is largely on the increase, it is reported that some of the more 'hollow-eyed' sorts, as the Adam's Pearmain, Cellini pippin, Reinette de Canade, Cox's Pomona, are frequently injured by the caterpillar of a tiny moth which bores into the kernels.

Life History. The perfect insect, the moth, makes its first appearance about the beginning of June and attacks the apples directly they have attained the size of large walnuts, or when the kernels are formed.

It belongs to the division *Carpocapsa* of the family *Tortricidæ* of the Nat. Ord. LEPIDOPTERA, and is a very pretty insect, though very small; its wing-breadth being only about 8 lines, or ⅔ inch, and its length of body rather less than 4 lines. Its fore, or upper wings, are of a lightish brown colour, becoming a deeper or darker brown towards their bases. At the tips of the fore wings there are oval patches of a rich golden hue, by which this insect can be at once identified. The hind or lower wings are brown, with a dark yellow tinge and a lustrous shimmer. When the moth is at rest it is insignificant looking, and escapes observation upon the bark or branches of apple trees and upon rails and fences near orchards, with its wings folded in the form of a

roof over its body. Like many other moths of this and other families, it flies from place to place and deposits its eggs in the twilight. Pairing takes place and the first eggs are placed in the calyces of the apples from about the end of May to the middle of June, according to the season. Only one egg is placed upon each apple, and is put, at least in the earlier part of the summer, into the calyces and upon the base of the eye of the fruit where the skin is tender, and where it will be protected from the weather and from other disturbing elements by the shelter of the persistent calyx. Many eggs are laid by each female; it is stated that in America the number of eggs laid by each female ranges from 80 to as many as 500. Mr Cooke, of Sacramento, reports that he has a phial in his possession containing 85 eggs laid by one moth. The eggs are hatched in about 10 days, and the larvæ, or maggots, begin at once to burrow through the rind and follow the tubes of the calyces to the pips, which appear to be the chief attraction.

The larva is a little more than half an inch in length. It is greyish-white in colour, having eight pairs of feet and a dark-coloured head. From time to time it pushes back little pellets of excrement and morsels of core and pulp gnawed off in its progress to its starting-point under the calyces. This collection is the first sign to all but the closest observers of the occupation of the fruit by this enemy. In about three weeks the larva is full grown, and has by this time eaten away the softer parts of the pips. Soon after this it bites its way from the centre to the nearest point in the circumference of the apple, and makes its exit. Generally the apple falls before the larva leaves it and after the pips are destroyed. When, however, the apple is still on the tree and the time has arrived for the larva to escape, it lets itself down to the ground gradually and gently by means of a silken cord. It proceeds then to wriggle its way to the nearest apple tree stem, and ascends it in order that it may conceal itself in a snug retreat in the bark. Here in some cases it constructs a kind of nest with pieces of bark knit together with silk from its body. In other cases it ensconces itself simply in a convenient cranny, and surrounds itself with silk, so that it is frequently asserted that it has then assumed the chrysalis form. It remains in larval form for some weeks, and then becomes a chrysalis in a silken cocoon. Accurate information is not forthcoming as to the period at which this stage is reached. I have found larvæ in their hiding-places on apple-stems in September.

Schmidberger, as shown in Köllar's work (*op. cit.*), declares that there are two generations of these insects in Germany. Taschenberg quotes this statement, but has not verified it himself. There are, without any doubt, two or more generations of the *Carpocapsa* in America during the summer. Mr Cooke writes thus: "From personal observation we know that the rule for the Sacramento Valley is three broods each year. This year (1881), on account of the early appearance of the first moths, we shall probably have four broods. These facts explain the exceptional importance of this insect in California" (*op. cit.*).

It seems clear that if there are not two broods in this country, and it is obviously most difficult to discover this, some of the moths come very late indeed from the chrysalis stage, as it has been noticed that in some seasons the attack has been continued even to the end of July. For instance moths have been seen laying eggs upon June-eatings and Keswick codlins at the end of May and in the same season margils and Cox's orange pippins have been attacked as late as the 27th of July. At these later periods it is by no means unusual for the moth to deposit the egg upon other parts of the apple than the eye. Sometimes the attack begins in the depression near the stalk or upon the circumference, but in the early part of the season the attack almost invariably commences at the eye.

Not infrequently the larva gets under the surface of the ground near where it has fallen, particularly if the apple trees are upon dug ground, or ground that is cultivated. They can be found under the clods near the trees, or in rubbish and dead leaves.

Prevention. To prevent the larvæ from taking upon the stems of the apple trees under the bark, the stems must be well scraped so that there may not be convenient hiding-places within the fissures.

'Windfalls' or 'drops' should be cleared away at once, especially if there are any signs of 'maggot' upon them. If these apples are small and immature, and not fit for sale to the 'smashers,' they should be given to the pigs or buried, in order that any larvæ within them may be destroyed. In cider-making districts the places where the apples have been laid in heaps should be treated with hot lime dug into the ground for some distance round. Should they be laid in lumps upon grass land, the grass must be cut very close for some distance round and a good dressing of gas-lime applied, or the land may be well watered with strong soapsuds, or ammoniacal liquid or liquid manure. As some of the larvæ are in the apples when they are gathered for storing, it is highly desirable that the walls and floors of the apple-room or storehouse should be treated with hot lime-wash or soft soap and quassia solutions, well brushed into the holes and cracks, to which the insects have betaken themselves to lie up for the winter.

A German gentleman named Krausz, of Stüttgart, recommends cutting off the calyces from the apple when they are about the size of walnuts, and before the *Carpocapsa* has come upon the scene, that they might not afford suitable shelter-places for its eggs. Mr Krausz reported that the fruit was in no way injured by this operation, and that in no case was an apple that had been thus treated affected by this insect. This method, as will be readily seen, could only be adopted by apple producers upon a very limited scale, in gardens, and upon bush-trees and other kinds that could be easily approached.

Remedies. There is nothing to be done when an apple has been 'struck' by this moth to remedy the evil caused to the particular apple—at least, nothing that would be applicable to fruit-growers upon a large scale, or to those having orchards. Gardeners and those who grow apples in a small way, and those who show apples, may

make use of an expedient for stopping the progress of this larvæ in the fruit, which consists of introducing a piece of wire, or better, a fine knitting-needle into the orifice in the eye of the apple, and pressing it so as to kill the intruder.

When the moths are very busy in the summer and the apples are falling fast, pieces of old oil-cake bags or old manure bags should be tied round the stems of the apple trees about a foot from the ground. These must be examined from time to time, and the larvæ found in the folds destroyed. This is practised in America and Canada, and it is one of the rules of the Board of State Horticultural Commissioners of California that this should be done in all orchards regularly in the month of May.

In the winter, after an attack, the stems of the apple-trees should be scraped, and hot lime worked well into the bark with a whitewash brush, or a strong mixture of soft soap and quassia, or of petroleum soap, or of paraffin and soft soap, applied by means of large stiff paint-brushes, or the softer kinds of ordinary scrubbing brushes. The grass must be brushed or mown off close all round the trees, and gas-lime put on, or pungent liquid manure ('Reports on Insects Injurious to Crops,' by Charles Whitehead, Esq., F.Z.S.).

CAR'RAGEEN. *Syn.* I''RISH MOSS; CHONDRUS, L. The *Chondrus crispus* of botanists, a well-known alga or seaweed. It contains a large proportion of a peculiar jelly, called carrageen'in or pect'in. This may be purified by agitation with dilute alcohol and filtration. The jelly forms an agreeable article of diet. It is used to a limited extent for thickening colours in calico printing. In *medicine*, carrageen is used in the form of a jelly and decoction as a demulcent, and is often prescribed in pulmonary complaints. See ALGÆ, FIXATURE, PASTE, SYRUP.

CAR'ROT. *Syn.* CARO'TA, L. The seed is carminative and diuretic; the expressed juice of the root is anthelmintic. Scraped raw carrot is sometimes employed as a stimulant application to sore nipples; the boiled root as a poultice to sores and tumours. As an article of food, unless young and well dressed, carrots are rather indigestible. Carrots can be kept for many months if the tops are cut out, and they are then placed in damp sand.

Analysis of Carrots.

Water	87·30
Albumenoids	0·66
Cellular tissue, gum, and non-nitrogenous substance	2·56
Sugar	5·54
Fibre	3·20
Mineral matters	·74
	100·00

CAR'THAMIN. $C_{14}H_{16}O_7$. *Syn.* PURE ROUGE, SAF'FLOWER CARMINE, SAFFLOWER LAKE. The red colouring matter of *Carthamus tinctorius* or safflower, formerly much used as a dye, particularly in the form of pink saucers for dyeing stockings.

Prep. 1. Safflower, exhausted by washing it with water (or with water acidulated with acetic acid), is dried, coarsely pulverised, and the powder digested in a weak solution of carbonate of sodium; pieces of clean white cotton or calico are then immersed in the solution, and acetic acid gradually added in slight excess; the cotton is next washed, dried, and digested in a fresh quantity of dilute solution of carbonate of sodium, and agitation employed until the whole of the colour is again dissolved; the new solution is filtered and slightly super-saturated with citric acid (or acetic acid); the carthamin, which falls down in rich carmine-red flocks, is lastly washed with cold distilled water and dried.

2. Washed safflower (dried and powdered), any quantity; aqueous solution of carbonate of sodium (containing 15% of carbonate), q. s. to form a thick paste; after some hours press out the red liquor, nearly neutralise it with acetic acid, put in cotton as before, and add acetic acid in slight excess; the next day remove the cotton and wash it in water holding in solution 5% of carbonate of sodium, until the colour is dissolved out, after which precipitate with citric acid, as before.

Prop., &c. An amorphous, brilliant, greenish powder; nearly insoluble in water, soluble in alcohol, forming a gorgeous purple solution, and in weak alkaline lyes giving an equally beautiful red one.

CAR'THAMUS. *Syn.* SAF'FLOWER. In *botany*, a genus of composite plants, the most important species of which is *Carthamus tinctorius*, the safflower. The florets of this yield a beautiful pink dye (see *above*), and are sometimes used to adulterate hay saffron. The 'cake saffron' of the shops consists entirely of safflower and mucilage. The fruits, commonly called 'seeds,' yield by expression the useful oil known in India as Koosum oil.

CARUM (PTYCHOTIS) AJOWAN. Ind. Ph. *Syn.* AJWAIN or OMUM PLANT. *Habitat.* Tropical Africa? Much cultivated in India.—*Officinal part.* The fruit (*Fructus ptychotis, Ajwain fruit*). Occurs in the form of minute umbelliferous fruits, which, examined with a lens, are seen to be covered with prominent tubercles, extremely aromatic, evolving, when rubbed, a strong odour resembling that of common thyme. Taste somewhat bitter, and very pungent. Its virtues reside in a stearopten and volatile oil.—*Prop.* Valuable stimulant, carminative, and antispasmodic.—*Therapeutic Uses.* In flatulence, flatulent colic, atonic dyspepsia, and diarrhœa, it is a remedy of much value.

OIL OF AJWAIN, or OMUM. (*Oleum ptychotis.*) The oil obtained by distillation from the fruit. Recently prepared, colourless, but soon acquires a yellowish tinge. It has the odour of the fruit, and an acrid burning taste. It contains THYMOL, a stearopten. Sp. gr. about 0·88.—*Dose*, 1 to 3 drops on sugar or in emulsion.

AJWAIN, or OMUM WATER. (*Aqua ptychotis.*) Take of ajwain fruit, bruised, 20 oz.; water, 2 galls. Distil a gallon.—*Dose*, 1 to 2 fl. oz. A valuable carminative; also useful in disguising the taste of disagreeable drugs, especially castor oil, and obviating their tendency to cause nausea and griping.

CARYOPH'YLLIN. $C_{10}H_{16}O$. *Syn.* CLOVE CAMPHOR, CLOVE RESIN. A crystalline substance,

isomeric with ordinary camphor, which deposits from oil of cloves in needles.

CARYOPH'YLLUS. See CLOVE.

CASCA BARK. *Syn.* SASSY BARK, ORDEAL BARK. The bark of *Erythrophælum Guineense*, a leguminous tree growing on the coast of Africa. It contains an alkaloid, *erythrophlæine*. The powdered bark, when inhaled, causes violent sneezing. A tincture, 1 in 10, is used in heart disease. —*Dose*, 5 to 10 minims.

CASCARA CORDIAL. (*Messrs Parke, Davis & Co.*) Cascara sagrada, 100 grms.; Berberis aquifolium, 37 grms.; diluted alcohol, 233 grms.; coriander, 17 grms.; angelica root, 2 grms.; oil of anise, 13 grms.; oil of orange, 13 grms.; oil of cassia, ·005 grm.; granulated sugar, 288 grms.; ext. glycyrrhiza fl., 12 grms.; tincture cudbear, q. s.; water, q. s. *ad* 1 litre. Make a decoction of the cascara sagrada at 212° F., and when cold filter, then dissolve the sugar in the resulting filtrate. Pack the coriander, berberis, and angelica (previously reduced to a coarse powder) in a percolator and displace with diluted alcohol, in which the oils have been previously dissolved. Lastly mix the cascara solution, the aromatic tincture, and the tincture of cudbear together, and then add the fluid extract of liquorice and enough water to make the product measure 1 litre.

Uses. Laxative; said to be a specific in chronic constipation, establishing a habit of regularity.

Dose. Extract 2 to 8 gr., liquid extract 10 to 60 minims.

CASCARA SAGRADA. *Syn.* SACRED BARK. The dried bark of *Rhamnus Purshianus*, native of S. America. Generally in quills or incurved pieces covered with a greyish-white layer, frequently marked with spots or patches of adherent lichens. Beneath the surface it is violet brown; internally, reddish brown. Sometimes sold in packets of small broken pieces of bark compressed into a compact mass of rectangular form.

Examinations of the bark have shown it to contain tannin, oxalic, and malic acids, a fixed and volatile oil, wax, starch, glucose, a ferment, and a crystallisable body. The agent to which the bark owes its laxative action is said to be a brown resin present in much larger quantity in old than in new bark. The ferment it contains brings about a change which gives the bark a griping action.

R. Wright, in the 'Year-book of Pharmacy, 1888,' gives the following formula for a tasteless fluid extract, which, whilst efficient in action, is free from the nauseous bitterness of the ordinary fluid extract. Take of Cascara bark in No. 40 powder, 1 lb.; calcined magnesia, 2 oz.; distilled water, $1\frac{1}{2}$ pints; proof spirit, a sufficiency. Mix the powders in a large mortar, and beat into a paste with water. Allow it to stand for 12 hours, and dry over a water-bath. Reduce the dry mass to powder, moisten with 18 oz. of proof spirit, pack in a percolator, add more proof spirit, and collect the first 14 oz. of percolate. Continue the percolation with proof spirit till the bark is exhausted; from this portion of percolate the spirit is removed by distillation, and the residual extract mixed with the previous 14 oz., and the whole made to measure 16 fl. oz. by addition of proof spirit.

CASCARIL'LA. *Syn.* CASCARILLÆ CORTEX (B. P.), L. The bark of *Croton Eluteria* or the seaside balsam, a tree growing in the Bahamas and Jamaica. It is an aromatic bitter, stomachic, and tonic.—*Dose*, 10 gr. to 30 gr., in the form of powder, infusion, or tincture; in diarrhœa, dysentery, dyspepsia, low fevers, intermittents, &c. Pieces of the bark are often burnt with tobacco to perfume the smoke.

CASCARIL'LINE, *Syn.* CASCARIL'LINA. *Prep.* (*Duval.*) Cascarilla is exhausted with cold water by percolation, precipitated with acetate of lead, and the filtrate treated with sulphuretted hydrogen; the filtered liquid, after agitation with animal charcoal and filtration, is gently evaporated to dryness. The powder is redissolved in boiling alcohol and crystallised by very slow or by spontaneous evaporation. It has a bitter taste and acid reaction; its aqueous solution is unaffected by the ferric salts and tincture of galls.—*Dose*, 1 to 3 gr.; in dyspepsia, &c.

CASE-HARD'ENING. *Syn.* STEEL SUR'FACING. The operation of giving a surface of steel to iron goods. Tools, fire-irons, fenders, keys, &c., are usually case-hardened.

Process. 1. The goods (finished in every respect but polishing), are put into an iron box, and covered with animal or vegetable charcoal and 'cemented' at a red heat for a period varying with the size and description of the articles operated on: these, when taken out are hardened by plunging into water, or oil, if they are of a delicate nature.

2. (*Moxon.*) Cow's horn or hoof is baked or thoroughly dried and pulverised; to this is added an equal quantity of bay salt, and the whole is made into a paste with stale chamber-lye, or white-wine vinegar; the iron is covered with this mixture, and bedded in it, in loam, or enclosed in an iron box. In this form it is laid on the hearth of the forge to dry and harden, then it is put into the fire, and blown till the lump has a blood-red heat (no higher). It is hardened as before.

3. Coat the goods with a paste made of a concentrated solution of prussiate of potash and loam; then expose them to a strong red heat, and when it has fallen to a dull red, plunge the whole into cold water.

4. The goods, previously polished and finished, are heated to a bright-red, and rubbed or sprinkled over with prussiate of potash. As soon as the prussiate appears to be decomposed and dissipated the articles are plunged into cold water.

Obs. The process of case-hardening has been well conducted when the surface of the metal proves sufficiently hard to resist a file. The last two plans are a great improvement upon the common method. By the topical application of prussiate of potash (ferrocyanide of potassium) any part or a piece of iron may be case-hardened without interfering with the rest.

Case-hardening Powders. *Syn.* CASE-HARDENING COMPOSITIONS. 1. Prussiate of potash, dried and powdered.

2. Prussiate of potash, 3 parts; sal-ammoniac, 1 part; mix.

3. Sal-ammoniac and bone-dust, of each, 2 parts; prussiate of potash, 1 part (see *above*.)

CA'SEIN. *Syn.* CA'SEUM, CA'SEIN, LACT-ALBUMEN, ALBUMEN OF MILK. The nitrogenous

principle of milk. Cheese made from skimmed milk and well pressed is nearly pure casein (*Liebig*).

Prep. 1. The curd obtained by adding dilute sulphuric acid to milk is well washed and dissolved in carbonate of soda. It is allowed to stand for 24 hours to let the oil rise to the surface, and when this is properly skimmed off, the casein is precipitated by an acid. The process is repeated a second time, and the coagulum digested with alcohol and ether, and dried. With all these precautions the casein still contains some saline matter which cannot be removed.

2. Milk is coagulated by hydrochloric acid, and the curd then well washed with dilute acid, and finally with pure water. The curd so prepared is dissolved by digestion at 110° F., with a large quantity of water; the solution, after filtration, is coagulated with carbonate of ammonia; the coagulum is washed with water, ether, and alcohol, and finally dried.

Prop., &c. Coagulated casein is readily dissolved by the alkalies and alkaline carbonates. The most remarkable property of casein is its coagulation by certain animal secretions, as in the process of cheese-making with rennet. See MILK.

CASKS. The care and management of casks is an important affair in a large establishment. It is found that they last longest when stored either in a dry situation, or in one uniformly very moist. Continual variations from the one to the other speedily rot them. As soon as casks are emptied they should be bunged down quite air-tight, with as much care as if they were full, by which means they will be preserved both sweet and sound. Should any of the hoops become loose they should be immediately driven up tight, which will at once prevent the liability of their being lost or misplaced, as well as the casks fouling or becoming musty from the admission of air. For this purpose those out of use should be occasionally hauled over and examined.

Numerous plans are adopted for CLEANING and PURIFYING CASKS, among which are the following:

1. Wash them well out with oil of vitriol, diluted with an equal weight of water.

2. Wash them first with a little chloride of lime and warm water, and then with water soured with oil of vitriol.

3. Match them with sulphur, or with sulphur mixed with a little saltpetre.

4. Unhead them and whitewash them with fresh milk of lime, made pretty strong. This plan is commonly followed for brewers' vats.

5. Remove the heads, and char the insides of the staves by the aid of a fire of shavings kindled within them.

6. A simpler, safer, and more effectual method of charring them than the last is to wash the dry casks out with strong oil of vitriol (sp. gr. 1·854). This not only purifies the surfaces of the staves, but penetrates into all the cracks, some of which might escape the action of the fire.

7. Steam has lately been applied to the insides of casks with great advantage. High-pressure steam is driven in at the bung-hole, at the same time that the cask is violently agitated (a heavy chain having been previously put into it), until all the dirt and bad smell is removed.

8. A lye of pearlash or soda, mixed with milk of lime, as well as strong hot brine, and other similar liquors, have been adopted by some persons, and are highly spoken of.

9. The coopers boil the staves for gin casks in a strong lye of alum before placing them together, to prevent their colouring the spirit; but washing with oil of vitriol is a better plan.

10. Some persons fill musty casks with water and add 3 or 4 *lbs.* of coarsely powdered fresh burnt charcoal, and agitate well for a few days.

11. Wash with bisulphite of lime.

Obs. In all the above processes the greatest care must be taken to scald or soak and well rinse out the casks after the treatment described. See BREWING, MATCHES, &c.

CAS'SAREEP. The expressed juice of the sweet cassava, concentrated by heat and flavoured with aromatics. It is used in the West Indies as a condiment. (See *below.*)

CAS'SAVA. A poisonous shrub cultivated in the West Indies and in many parts of South America for the sake of the starchy matter contained in its roots. It belongs to the Nat. Ord. EUPHORBIACEÆ, and is known to botanists under the names ***Manihot utilissima***, Pohl, ***Janipha manihot***, Humboldt, and ***Jatropha manihot***, Linn., the former being that now generally adopted. The name 'bitter cassava' is commonly given to it in the West Indies, to distinguish it from another species of the same genus, ***Manihot aipi***, Pohl, which, from having no poisonous properties, is named the 'sweet cassava.' The roots of both species yield the starch, but those of the poisonous plant are the richer.

The roots, after being well washed and scraped, are rasped or grated, and the pulp thus formed is subjected to strong pressure, to expel the poisonous juice which it contains. The compressed pulp is next thoroughly dried over the fire, being constantly stirred the whole time, by which any remaining portion of the noxious juice is either volatilised or decomposed. It now forms CASSAVA MEAL. When it is further prepared by grinding, it forms FINE CASSAVA MEAL or CASSAVA FLOUR. When the compressed pulp is baked on a hot plate, it forms CASSAVA BREAD or CASSAVA CAKES, the flavour of which greatly resembles that of Scotch oat-cakes. See TAPIOCA.

CAS'SIA. In *botany,* a genus of the Nat. Ord. LEGUMINOSÆ, including several important medicinal plants. The 'purging cassia,' *Cassia fistula,* Linn., produces pods containing a soft, blackish pulp. See *below,* also SENNA.

Cassia Pulp. *Syn.* CASSIA PREPARA'TA, CASSIÆ PULPA (B. P.), L. *Prep.* The cassia (pods or fruit), broken lengthwise, are macerated in sufficient distilled water to cover them for 6 hours, constantly stirring; and the purified pulp strained through a hair sieve, and evaporated to the consistence of a confection in a water-bath.—*Dose.* As a mild laxative, 1 to 2 dr.; as a purgative, $\frac{3}{4}$ oz. to $1\frac{1}{2}$ oz.

CASSOLETTES (Scented). See PASTILLES and PERFUMERY.

CASTOR. *Syn.* CASTO''REUM, L. "The follicles of the prepuce of the *Castor fiber* or ***beaver*** filled with a peculiar secretion." It is often sophisticated; a fraud readily detected by the "absence

of the membranous partition in the interior of the bags, as well as by the altered smell and taste" (*Ure*). Russian castor, which is very rare, may be distinguished by a tincture of 1-16th part in alcohol, being of the colour of deep sherry, while that with American castor is of the colour of London porter (*Pereira*).—*Dose*, 1 to 2 dr. or more, in powder or made into pills; in nervous and spasmodic affections, especially in hysteria, epilepsy, and other like diseases of females.

CASTOR CAKE. The crushed and closely-pressed seeds of the *Ricinus communis*, after the expression of the oil, are said to be sometimes employed as a cattle-food, and have the following composition:

Moisture	9·95
Organic matter	81·07
Phosphate of lime and magnesia	4·49
Alkaline salts	1·80
Sand	2·69
	100·00

This cake, even when mixed with large quantities of linseed cake, &c., is intensely poisonous. A pupil of the late Dr Tuson states, however, that in India, castor cake, after exposure to the sun is commonly and safely used as a food for cattle.

CASTORIN. *Syn.* Castoreum Camphor. A crystalline substance obtained by digesting genuine Russian castor with 6 times its weight of boiling alcohol. It has the odour of castor, is inflammable and soluble in ether and hot alcohol.

CASTOR OIL. See Oils.

CASTS. In preparing casts and moulds with gelatin, wax, fusible metal, and similar substances, it is important to use them at the lowest temperature compatible with fluidity; as when only a few degrees hotter the water which adheres to the things from which the casts are taken is converted into a vapour, and produces bubbles. Fusible metal may be allowed to cool in a teacup until just ready to set at the edges, and then poured into the moulds. In this way beautiful casts from moulds of wood, or of other similar substances, may be procured. When taking impressions from gems, seals, &c., the fused alloy should be placed on paper or pasteboard, and stirred about till it becomes pasty, from incipient cooling, at which moment the gem, die, or seal should be suddenly stamped on it, and a very sharp impression will then be obtained.

Casting from Life. Casting a hand or foot is simple when one side only has to be moulded. Take the hand—the back only to be shown; singe it well. Rub a very little olive oil over the skin, place it palm downwards on a cloth so arranged as to fill up the hollows beneath as far as possible, and pour on the plaster. When this is set (say in 5 minutes), the cloth may be pulled away and the mould eased with a knife where necessary to let the fingers be drawn out. Well rinse the mould with clean water, and it is ready for making the cast, either in plaster or wax. If both back and palm or to be moulded, bury half of the hand in sand, mould it, turn it, and clean sand from edges of mould, which brush over with clay and water to prevent the two pieces of the mould adhering. Make second half of mould, remove the hand, and tie the two pieces tightly together before filling.

Casts, Plaster. The mould should be very carefully oiled in *every* part, and all excess removed before pouring in the cream of plaster of Paris. In casting a statue in plaster from the sculptor's model in clay, the model is first covered with a thin cream of the very finest plaster (*scagliola*), and on this a layer of rather coarser plaster is laid—tinted with some colour. The whole is then strengthened by large quantities of common plaster, sufficient to make the individual pieces solid and capable of being handled. The divisions of the mould are made by means of pieces of very thin sheet-brass stuck into the clay model with great care along lines which will enable the mould to be removed with care. When the mould is complete and dry, it is taken off the clay model, set up in the correct position, and carefully filled with plaster. The mould is then broken away with tools until the coloured layer is reached, when the operator exercises extra care, as he knows he is near the surface of the cast.

CATALEPSY. *Syn.* Trance; Catalep'sis, Catalep'sia, L. A nervous disorder, characterised by attacks of powerlessness and unconsciousness, with rigidity of the limbs and muscles. It is far more common in women than in men, and is generally associated with hysteria. The treatment is determined by the nature of the attacks and their possible cause. Remedies useful in hysteria will be of service. Emetics and local stimuli will generally rouse the patient. The condition is more or less serious, and skilled advice should always be sought.

CAT'APLASMS. See Poultices.

CAT'ARACT. An opaque condition of the lens of the eye. It is a common cause of blindness. It can only be cured by a surgical operation.

CATARRH. *Syn.* Catarrh'us, L.; Catarrhe, Coryza, F.; Katarrh, Schupfen, Ger. The 'cold in the head,' or 'cold on the chest,' of domestic medicine. Influenza is a severer form of this complaint, and has been called epidemic catarrh.

The common symptoms of catarrh are a copious discharge from the eyes and nose, a hoarseness, and generally a cough, more or less severe. The exciting causes are sudden changes of temperature and exposure to currents of cold air while the body is heated; hence the frequency of colds in hot and changeable weather.

The term is applied by writers on medicine to any inflammation of the mucous membranes accompanied by increased secretion, *e.g.* catarrh of the stomach, bladder, intestines, &c.

Treatm. A light diet should be adopted, and animal food and fermented and spirituous liquors should be particularly avoided. Some mild aperient should be administered; and when the symptoms are severe, or fever or headache is present, small diaphoretic doses of antimonials, accompanied by copious draughts of diluents, as barley water, weak tea, or gruel should be taken. This treatment, except in very bad cases, will generally effect a cure.

In some individuals a catarrh of the air-passages, *i. e.* a common cold, proves very obstinate

and difficult of cure. In these cases complete change of air is often effectual. Such persons should be especially careful to avoid exposure; should wear woollen underclothing at all times, be careful of their general health, and avoid hot and ill-ventilated rooms.

The following will be found a serviceable mixture: Mendererus spirit, 1½ oz.; sweet spirit of nitre, 2 dr.; syrup of sugar, ½ oz.; camphor mixture, enough to make a 6-oz. mixture. An adult may take two tablespoonfuls of this mixture every 3 or 4 hours. Should the cold in the head be severe and accompanied with cough, it has been recommended to inhale the vapour of pure washed ether by drawing it alternately into the nostrils from a wide-mouth bottle holding about 1 oz., and clutching it in the warm hand until ¼ oz. has been volatilised. This repeated 2, 3, or 4 times in 48 hours is said to effect a cure within that time. This remedy must be used with the greatest caution. Persons liable to colds are advised to use the cold bath.

Dr Ferrier's Remedy for a Cold in the Head. Hydrochlorate of morphine, 2 gr.; powdered gum arabic, 2 dr.; subnitrate of bismuth, 6 dr. Mix. Let a very small quantity be sniffed up the nose every 5 minutes for 20 or 30 minutes.

Another Remedy. Carbolic acid, 10 drops; tincture iodine; chloroform, of each, 7½ grms. Place a few drops in a test-tube, and heat cautiously over a spirit-lamp, and when it boils remove and inhale by the nose. Repeat after a few minutes. Two inhalations are said to be sufficient to cure a cold in the head ('Year-book of Pharmacy').

In HORSES, catarrh is caused by sudden changes of temperature, draughts, and faulty ventilation. Let the animal have plenty of cool fresh air, the body being kept warm by means of horse-cloths and bandages. If necessary, give a mild physic-ball, or a clyster; keep it on a soft, laxative diet, and give it an ounce of nitre daily. Should there be sorethroat or troublesome cough apply a mild blister of cantharides or mustard.

CAT'ECHIN. *Syn.* CATECHU'IC ACID, RESINOUS TAN'NIN. When cubical gambir or catechu, in powder, is treated with cold water, a portion remains undissolved. This is catechin. By repeated solutions in alcohol it may be obtained under the form of white, silky, acicular crystals.

Prop, &c. Catechin strikes a green colour with the salts of iron, but does not precipitate gelatin. When dissolved in caustic potash, and the solution exposed to the air, it absorbs oxygen, and japonic acid is formed. If, instead of caustic potash, carbonate of potash is employed, it is converted into rutic acid.

CATECHU. *Syn.* CAS''HEW, CUTCH, GAM'BIR; CAT'ECHU (Ph. L. E. & D.), TER'RA JAPON'ICA, L.; CACHOU, Fr. "The extract from the wood of *Acacia catechu*, or from the leaf of *Uncaria Gambier*" (PALE CATECHU, Catechu Pallidum, B. P.). Also of the "kernels of *Areca catechu;* probably, too, from other plants" (Ph. E.). The term is now applied to several extracts similar in appearance and properties to that of *Acacia catechu.*

There are several varieties of catechu known in commerce, of which the principal are:

Catechu, Bombay. Firm, brittle, dark brown, of a uniform texture, and a glossy, semi-resinous, and uneven fracture. Sp. gr. 1·39. Richness in tannin, 52%.

Catechu, Bengal. Rusty-brown colour externally; porous, and more friable than the preceding. Sp. gr. 1·28. Richness in tannin, 49·5%.

Catechu, Malabar. Resembles the last in appearance, but is more brittle and gritty. Sp. gr. 1·40. Richness in tannin, 45·5%.

Of the above varieties the first is the one generally employed in medicine, and which commonly passes by the name of catechu. The second popularly passes under the name of *Terra japonica* (Japan earth) from the old belief that it was of mineral origin.

Catechu, Pale, is prepared at Singapore, and in the Eastern Archipelago. It generally occurs in cubical reddish-brown pieces, porous, bitter, and astringent in taste. Entirely soluble in boiling water; the solution, when cold, is not rendered blue by iodine. Of 100 parts, only 50 to 60 are dissolved by cold water, and the solution is bright. Thirty parts of isinglass precipitate the whole of the astringent matter.—*Test.* Sp. gr. 1·39. "The pale catechu is in the B. P.; but the black is one adopted by most other pharmacopœias, and is preferred in the arts and manufactures; it is well known to be far superior to the pale in astringency, and is always to be had of good quality; it is therefore a matter of surprise and regret that it has been rejected from the British Pharmacopœia" (*Squire*).

Estim. It is often of importance to the tanner and dyer to determine the richness of this article in tannic acid or tannin. The following are two simple methods:

1. Exhaust a weighed sample (in powder) with ether, and evaporate by the heat of a hot-water bath. The product, which is the tannin, must then be accurately weighed.

2. Dissolve the sample (in powder) in hot water, let it cool out of contact with the air, filter, and add a solution of gelatin as long as a precipitate falls. The precipitate, after being washed and dried at a steam-heat contains 40% of tannin.

Uses, &c. Catechu is extensively employed in medicine, both internally and externally, as an astringent. It is used to flavour British brandy, and by the tanners as a substitute for oak bark. With it the dyer produces, inexpensively, many of his most pleasing browns. Alum mordants are mostly employed in dyeing with catechu. "The salts of copper with sal-ammoniac cause it to give a BRONZE COLOUR, which is very fast; the protochloride of tin, a BROWNISH YELLOW; the perchloride of tin, with the addition of nitrate of copper, a DEEP-BRONZE HUE; acetate of alumina, alone, a REDDISH BROWN, and with nitrate of copper, a REDDISH-OLIVE GREY; nitrate of iron, a DARK-BROWN GREY. For dyeing a GOLDEN COFFEE-BROWN, it has an entirely superseded madder; 1 *lb.* of it being equivalent to 6 *lbs.* of this root" (*Ure*).—*Dose,* 10 gr. to 30 gr. in solution, in water, or made into a bolus, or sucked as a lozenge.

CATERPILLARS ON FRUIT TREES. The following appeared in the public Press in May, 1889, at the request of the Board of Agriculture:

The Board being advised that caterpillars are now present in number on the fruit trees, consider it desirable to publish information with regard to remedial measures to be taken against them.

Upon examination of the leaf-buds and blossom-buds of fruit trees, and especially those of apple trees, it will be seen that many tiny greyish caterpillars are already at work eating the leaves while they are still unfolded, or slowly unfolding.

The caterpillars are so small as to escape notice unless the attention is specially directed to them; but they can be found in alarming numbers in many orchards and fruit plantations, particularly in those in which so much mischief has been occasioned in the last two years, and it is most important that steps should be taken at once to check their progress.

First, it should be noted that syringing the trees infested with caterpillars proved advantageous in many places in the last season; it was more particularly useful in respect to plum, damson, and small apple trees. The large old apple trees were beyond the reach of ordinary machines used for this purpose, and it was only in hop-growing districts, where hop-washing machines are generally used, that the systematic syringing of standard trees was adopted. The machines can be moved about easily enough in orchards. In plantations, with fruit bushes under the standards, it is more difficult to move them about and to get the supplies of liquid brought through the thick undergrowth.

The mixtures employed for syringing fruit trees are:

1. The extract of 10 *lbs.* of quassia, obtained by boiling quassia in water, to 100 galls. of water, and 7 *lbs.* of soft soap.

2. The extract of 5 *lbs.* of quassia to 100 galls. of water, with 6 *lbs.* of soft soap and 4 pints of paraffin, well stirred.

3. The extract of 5 *lbs.* of quassia, to 100 galls. of water, with 6 *lbs.* of soft soap and 4 pints of Calvert's carbolic acid, No. 5.

4. 8 *lbs.* of soft soap and 2 *lbs.* of finely ground hellebore, and a quart of paraffin, boiled and well stirred together. This is sufficient for 100 galls. of water.

The soft soap is dissolved in a tub with hot water. The quassia chips are boiled in water and put into another tub. Where paraffin is used it should be well stirred up in boiling soap and water before it is mixed with the quassia water. Water-carts, ordinary barrels, or wine-casks set upon frames with wheels, are brought full of water to where the materials are being prepared, either at the farm buildings, or in an extemporised shed with a copper in it, and the requisite amount of dissolved soap and other ingredients is added. The cart is then driven to the scene of action, the materials being kept well mixed by the jolting.

It is important that syringing should be done at once, as, to be effective, it must be commenced early. Directly there are signs of infestation the process should be begun. As the hatching out of caterpillars is not simultaneous, but is extended over some days, the syringings must be renewed.

Secondly, fruit growers in several parts of the country are now for the first time trying the arsenical insecticides used extensively in the United States and Canada. These have not been hitherto adopted in this country on account of their poisonous properties. The time has now arrived when they should be fully tried.

There are two special substances of this nature. The one, 'Paris green,' or 'emerald green,' is strongly recommended by several American and Canadian entomologists.

Professor Lintner, the entomologist of the State of New York, in a recent letter, says that, in his opinion, fruit growers who do not use Paris green as a remedy against caterpillars infesting fruit trees are guilty of culpable negligence. Professor Lintner believes that the produce of fruit land may be doubled by the judicious use of this substance.

A trial of this is urged. Care must, however, be taken to observe strictly the regulations laid down for its use, or injury will be caused to the foliage and blossoms. The latest advice from experienced practical entomologists is to put 1 *lb.* of the Paris green into 165 to 210 galls. of water. The mixture must be kept well stirred, in order that the solution may be maintained at a uniform strength. Paris green solutions must be sent in the form of spray or mist upon the leaves, and not squirted violently against them.

The object is not to dislodge the caterpillars, but to poison them with the arsenical solution, which should fall like gentle rain upon the leaves. For this purpose fine 'rose' jets should be used. Riley's 'cyclone nozzle' is used in America. Messrs. Blundell, Spence and Co., of Upper Thames Street, London, supply Paris green at 1*s.* per *lb.*

The other arsenical compound is 'London purple,' obtained in the manufacture of aniline dyes, and composed of lime and arsenious acid. It is highly recommended by Professor Riley, the well known entomologist of the United States Department of Agriculture, who reported in 1885 that it has an advantage over Paris green in cheapness, better diffusibility and visibility upon the foliage; and experience showed that the Paris green injured the foliage more than the London purple.

1 *lb.* of London purple should be mixed with from 140 to 150 galls. of water, and kept well stirred, being applied in the form of a heavy dew or mist.

London purple can be obtained at Hemingway's, 60, Mark Lane, E.C., at about 7*d.* per *lb.*, as a powder, and in a fluid form ready for mixing with water. It is as poisonous as Paris green.

Stock must not be put on grass in orchards where these arsenical solutions have been used on the fruit trees until a considerable period has elapsed and rains have fallen, nor must they be used where vegetables are grown under the trees. Three or four days will elapse before the effect of these solutions is apparent. As a rule, it will be found necessary to repeat the application when the leaves are fully out. It is believed that Paris green and London purple will be destructive to the larvæ of the *Anthonomus pomorum*, the apple-blossom weevil, whose presence has already been remarked in apple-blossom buds. This

insect occasioned an enormous amount of harm last spring. These solutions can be put on with hop-washing engines, ordinary garden engines, hydronettes, and other pail engines, such as Snow's universal engine.

CAT'GUT. The prepared and twisted intestines of animals. *Prep.* The guts, taken whilst warm from the animal, are thoroughly cleaned, freed from adherent fat, and well rinsed in pure water. They are next soaked for about 2 days in water, after which they are laid on a table and scraped with a copper-plate, having a semicircular notch, beginning the operation at the smaller end. In this way the mucous and peritoneal membranes are removed. The guts are then put into fresh water, and soaked until the next day, when they are again scraped, the larger ends cut off, and after well washing, again steeped for a night in fresh water, and then for 2 or 3 hours in a weak lye of pearlash or potash (2 *oz.* to the gall.). They are lastly washed in clean water, and passed through a polished hole in a piece of brass to smooth and equalise their surface; after which they are twisted, and sorted, according to the purposes for which they are intended. For many purposes the prepared gut is dyed or sulphured, and rubbed with olive oil. It improves by age. Red or black ink, or any of the simple dyes or stains, are used to colour it.

Uses, &c. Catgut is employed in several of the arts. The strings of harps, violins, &c., are formed of this material. Whipcord is made from catgut, which is sewed together while soft with the filandre or scrapings, after which it is put into a frame and twisted. Bowstrings for hatmakers are made out of the largest intestines, 4 to 12 of which are twisted together, until the cord is extended to 15 to 25 feet in length. It is then rubbed perfectly smooth and free from knots, half dried, sulphured twice, again stretched and sulphured, and lastly dried in a state of tension. Clockmakers' cords are made of the smallest intestines in a similar manner. Catgut soaked in carbolic oil is used by surgeons for ligatures.

The best fine catgut is made at Venice or Rome, from the intestines of thin, sinewy sheep. That made in England is formed from the fat sheep killed for the shamble, and is, hence, inferior. Coarse catgut, for turning lathes, &c., is made from the intestines of horses, cut into 4 or 5 strips, by forcing a ball furnished with projecting knives placed crosswise along them. These strips are next twisted, dried, and rubbed smooth with fish skin. Gutta percha and vulcanised india rubber are now applied to many of the purposes formerly exclusively occupied by catgut.

Imitation Catgut. Twine may be given the appearance of catgut by soaking for about half an hour in thin glue; drying and soaking for 2 or 3 hours in a strong infusion of oak bark and catechu; drying and rubbing with a rag saturated with oil.

CATHARTIC ACID. *Syn.* ACIDUM CATHARTICUM, L. A glucoside obtained from senna leaves. To prepare it an infusion of senna is treated with an equal volume of 75% alcohol, then filtered. The filtrate is evaporated to a small volume and precipitated with absolute alcohol. This treatment yields a black substance which is dissolved in water, and finally precipitated with hydrochloric acid, yielding cathartic acid as a precipitate.

Uses. It has the purgative properties of senna, but causes no nausea or griping.—*Dose*, 2 to 8 gr.

CATHAR'TICS. See PURGATIVES.

CATHAR'TIN. The purgative principle of senna, first noticed by Lassaigne and Fenuelle. A strong aqueous infusion of senna leaves is evaporated to the consistence of a syrup, out of contact with the air; this fluid extract is then digested in alcohol or rectified spirit, and the tincture, after filtration, is evaporated to dryness by a gentle heat.

Prop., &c. A reddish-coloured, uncrystallisable mass; having a peculiar odour and a bitter, nauseous taste; freely soluble in both water and alcohol, and strongly cathartic. 2 or 3 gr. cause nausea, griping, and purging. It has been proposed to employ it, combined with aromatics as a cathartic.

CATH'ETERS. Small tubes introduced into the bladder for the purpose of drawing off its contents. They may be regarded as hollow bougies.

Prep. 1. A piece of smooth catgut, or steel wire, bent to the proper shape, is coated with melted wax. When cold it is dipped repeatedly into an ethereal solution of india rubber, until a sufficient thickness is obtained, after which it is dried by a gentle heat, and then boiled in water to melt out the wax, and to allow the catgut to be withdrawn. A solution of india rubber in bisulphide of carbon is now generally employed instead of an ethereal solution.

2. From slips of india rubber, as directed under BOUGIES.

3. A smooth tissue of silk is woven over a bent wire, and then coated with a surface of india rubber, or elastic varnish, and finished off as before. See BOUGIES.

CAUDLE. Gruel enriched by various additions.

Prep. 1. Thick oatmeal gruel mixed with about one half its weight of good mild ale (made hot), and as much sugar, and mace, nutmeg, or ginger, as will make it agreeable.

2. To the last add an egg, well beaten.

3. Sugar, 3 or 4 lumps; hot water, a tablespoonful; dissolve; add 1 egg; beat well together; further add a glass of wine and a little nutmeg or ginger; mix well, and stir the mixture into good gruel (hot), ¾ pint.

Uses, &c. A nourishing and restorative mixture during convalescence, much used among certain classes after accouchement. It is an excellent domestic remedy for colds, &c., unaccompanied with fever; for which purpose it should be taken on retiring to rest at night, preceded by a dose of castor oil during the day.

CAULIFLOWER (*Brassica botrytis*). Cauliflower is often confounded with broccoli (*Brassica cymosa*), but the two are distinct. The former is easily injured by even slight frost, the latter bears the English winter very well.

The Walcheren cauliflower or broccoli is a variety between the two, but whilst there are many varieties of broccoli there are only two sorts of cauliflower, viz. the early and late.

Cauliflowers are to be reckoned among the more nutritious vegetables, and the ash, as will be seen from the subjoined analysis, contains a large amount of mineral matter:

Ash of Cauliflower.

Potash	34·39
Soda	14·79
Magnesia	2·38
Lime	2·96
Phosphoric acid	25·84
Sulphuric acid	11·16
Silica	1·92
Phosphate of iron	3·67
Chloride of sodium	2·78

CAULOPHYLLIN. *Syn.* CAULOPHYLINUM, L. A brown resinoid substance obtained from the root of *Caulophyllum thalictroides.* The method of preparation is the same as for podophyllin. It acts as an antispasmodic, emmenagogue, parturient, and diaphoretic.—*Dose,* 1 to 4 gr. in pill.

CAUS'TIC. *Syn.* CAUS'TICUM, ESCHAROT'ICUM, L. A substance that corrodes or destroys the texture of organised bodies. This action is popularly termed 'burning.'

The principal caustics are nitrate of silver, caustic potash, a mixture of caustic potash and quicklime, sulphate of copper, red oxide of mercury, verdigris, tincture of perchloride of iron, chloride of zinc, chloride of antimony, nitric acid, acetic acid, carbolic acid, chromic acid, and sulphuric acid.

Use. Caustics are employed to remove excrescences, morbid growths, granulations, &c., as corns, warts, and proud flesh; and to open issues, abscesses, &c. The first, second, and fourth are applied by gently rubbing them on the part previously moistened with water; the third is commonly made into a paste, with rectified spirit or glycerin, before application; red oxide of mercury and verdigris (in the form of powder) are often sprinkled over foul and indolent ulcers; whilst the acids and other liquid caustics are applied with a feather, camel-hair pencil, or glass rod. The same applies to the liquid preparations below. In all cases care should be taken to confine the application to the affected part.

Caustic, Ammoni'acal, See OINTMENTS, and CAUSTIC, GONDRET'S.

Caustic, Antimo''nial. *Syn.* CAUSTICUM ANTIMONIA'LE, L. Chloride of antimony.

Caustic, Arsen'ical. *Syn.* CAUSTICUM ARSENICA'LE, C. ARSENIO'SUM, C. A. COMPOS'ITUM, L. *Prep.* 1. See CAUSTIC, PLUNKET'S.

2. (Cutan. Hosp.) Calomel, 2½ oz.; red sulphide of mercury, 1 dr.; arsenious acid, 1 dr. to 2 dr.

3. (*Van Mons.*) Arsenious acid, 6 dr.; dragon's blood, 2 dr.; animal charcoal, 1½ dr.; cinnabar, 3 oz.

4. (*Ratier.*) Arsenious acid, 1 part; kino, 8 parts; cinnabar, 16 parts. The ingredients of the last three must be separately reduced to fine powder, and then carefully mixed. They are favourite applications on the Continent in cases of cancer, cancerous sores, obstinate lepra, &c. They are either dusted over the part, or are made into a paste with mucilage or the saliva, and applied like an ointment on a piece of rag or lint; due caution being observed, and the effects watched. The last is much used in the French hospitals.

Caustic, Canquoin's. See ZINC CAUSTIC.

Caustic, Canthar'ides. *Syn.* CAUSTICUM CANTHARI'DIS, L. *Prep.* 1. Powdered cantharides made into a paste with concentrated acetic acid.

2. (Cutan. Hosp.) Tannin, 1 oz.; cantharides (powdered), 2 oz.; strong acetic acid, 8 oz.; digest a week, and strain. Blisters.

Caustic, Common. See POTASH (HYDRATE OF), and CAUSTIC POTASH WITH LIME.

Caustic, Duville's *Prep.* 1. Aloes, 5 oz.; proof spirit, 10 oz.; oil of vitriol, 6 oz.; mix.

2. Aloes (in powder), 2½ oz.; rum, ¼ pint; mix, and the next day add, oil of vitriol, 1 oz. A favourite caustic in veterinary practice, especially in foot-rot.

Caustic, Filho's. *Prep.* From caustic potash, 2 parts; quicklime (in powder), 1 part; melt together in a ladle, mix well, and pour it into small leaden tubes, the size of a large swan-quill. When cold, coat each piece with melted beeswax, to exclude the air. Used as a strong caustic in veterinary practice. It is applied like nitrate of silver.

Caustic, Golden. *Syn.* CAUSTIC OF CHLORIDE OF GOLD; CAUSTICUM AUR'EUM, C. AUR''II CHLOR'IDI, L. *Prep.* 1. (*Recamier.*) Terchloride of gold, 6 gr.; nitrohydrochloric acid, 1 oz.; dissolve.

2. (*Legrand.*) As the last, but using nitric acid. Both are recommended as caustics in syphilitic, scrofulous, and scorbutic ulcers, cancerous growths, &c.; applied by means of a dossil of lint.

Caustic, Gondret's. *Syn.* GONDRET'S AMMONI'ACAL CAUSTIC; POMMADE DE GONDRET, Fr.; CAUSTICUM AMMONIACA'LE, L. *Prep.* 1. See OINTMENT, AMMONIACAL.

2. (Original formula.) Almond oil, 2 dr.; suet, 4 dr.; lard, 6 dr.; melt together in a wide-mouthed bottle, cool a little, add solution of ammonia, 12 dr.; and agitate until cold. A powerful rubefacient and counter-irritant; used to produce an immediate revulsion. If covered with a compress, it raises a blister in 4 or 5 minutes.

Caustic, I'odine. *Syn.* CAUSTICUM IODIN''II, L. *Prep.* (*Lugol.*) Iodine and iodide of potassium, of each, 1 part; water, 2 parts; dissolve. Used in similar cases to iodine paint, and to scrofulous growths and ulcers.

Caustic, Lu''nar. *Syn.* LA'PIS INFERNA'LIS, L. *Prep.* 1. Nitrate of silver fused and formed into sticks by pouring it into moulds.

2. (*E. R. Squibb.*) Nitrate of silver fused with a small quantity of chloride of iron, and formed into sticks or points. The chloride of iron gives toughness to the caustic.

Caustic, Mercu''rial. *Syn.* CAUSTIC OF NITRATE OF MERCURY; CAUSTICUM AC'IDI HYDRAR''GYRI NITRA'TIS, C. H. DEUTRONITRATIS, L. From mercury, 1 part; commercial nitric acid, 2 parts; dissolve.

2. (Cutan. Hosp.) Mercury, 1 part; nitric acid (sp. gr. 1·5), 2 parts.

3. (P. C.) As No. 1, but evaporating the solution to 3-4ths its weight. These liquids are applied with a pencil or lint, in scrofulous and

syphilitic ulcers and eruptions, and in lupus, psoriasis, lepra, and other obstinate skin diseases; but their use requires great care.

4. (With arsenic. Cutan. Hosp.) Mercury, ½ oz.; nitric acid, ½ oz.; arsenious acid, ½ dr.; as before.

Caustic, Mitigated. (B. P.) Mix and fuse in a capsule of platinum or porcelain 1 oz. of nitrate of silver and 2 oz. of nitrate of potassium. Pour the melted mass into proper moulds.

Caustic, Ni′tric. *Syn.* SOLID′IFIED NITRIC ACID; CAUSTICUM NITRICUM, L. *Prep.* (*Dr Rivallie.*) Concentrated nitric acid is gradually dropped on a piece of lint, placed in a saucer or glass; as soon as the lint is gelatinised it is pressed into a suitable shape with a glass rod and applied to the part; it must be removed in 15 minutes. In cancerous tumours, fungoid growths, &c.

Caustic, O″piated. *Syn.* CAUSTICUM OPIA′TUM, L. *Prep.* 1. Common caustic (potassa with lime), 4 dr.; powdered opium, 1 dr.; soft soap, q. s. to make a paste. Applied to fungous ulcers.

Caustic, Plunket's. Upright crowfoot and lesser spearwort, of each, 1 oz.; sulphur, 5 scr.; white arsenic (in very fine powder), 1 dr.; beat to a smooth paste, form it into balls, and dry them in the sun. In cancer; a portion of one of the balls is reduced to powder, which is mixed up with yelk of eggs, and applied on a piece of bladder.

Caustic Potash with Lime. *Syn.* VIENNA PASTE. Rub together equal parts of hydrate of potash and quicklime, and keep the powder in a well-stoppered bottle.

Caustic, Poten′tial. Fused caustic potash.

Caustic, Recamier's. See CAUSTIC, GOLDEN.

Caustic, Sulphu″ric. *Syn.* CAUSTICUM SULPHU″RICUM, C. AC′IDI SULPHU″RICI, L. *Prep.* 1. Plaster of Paris made into a paste with oil of vitriol.

2. Saffron, lint, or unsized paper, soaked in oil of vitriol, and triturated to a plastic mass.

Caustic, Zinc. *Syn.* CAUSTIC OF CHLORIDE OF ZINC, Dr CANQUOIN'S CANCER CAUSTIC; CAUSTICUM ZINC′I, C. Z. CHLORID′I, L. *Prep.* 1. (*Dr Canquoin.*) *a.* From chloride of zinc, 1 dr.; flour, 2 dr.; made into a stiff paste with water, q. s.

b. From chloride of zinc, 1 dr.; flour, 3 dr.; water, q. s.; as the last.

c. From chloride of zinc, 1 dr.; flour, 4 dr.; water, q. s.; as before.

d. From chloride of zinc, 2 dr.; chloride of antimony, 1 dr.; flour, 5 dr.; as before.

Powdered opium may be mixed with either of the preceding to mitigate the pain.

2. (*Alex. Ure.*) As above, but substituting plaster of Paris for the flour there ordered.

Uses, &c. As a caustic in cancer, lupus, skin-marks (*nævi*), &c. It is formed into small cakes or wafers not exceeding 1 or 2 lines in thickness, one of which is applied to the part, and allowed to remain on from 6 to 12 hours, when it is removed, and the part covered with a poultice. It produces an eschar often exceeding ¼ inch in depth. The chlorides must be in the form of powder, and well mixed with the flour previously to adding the water. The last (No. 1, *d*) is recommended in nodulated cancerous tumours.

CAUSTICS (Ve′terinary). In *veterinary practice,* any of the substances enumerated in the foregoing list may be employed; but nitric acid, sulphuric acid, carbolic acid, chloride of zinc, and nitrate of silver are those most commonly used. See VETERINARY MEDICINES.

CAV′IARE. *Syn.* CAV′IAR, CAV′IALE. The salted roe of several species of sturgeon. It is much esteemed by the Russians as well as by some other nations of Northern Europe, and is occasionally eaten as a delicacy in this country. It is, however, very oily, indigestible, and unwholesome.

CAYENNE′. See CAPSICUM, PEPPERS.

CECIDOMYIA TRITICI, Kirby. The Wheat-midge. In most seasons quantities of these midges—tiny flies—are seen late in the evening flying near wheat-fields in the early part of June, just at the time when the wheat ears are beginning to appear. Later on many will be found within the wheat-ears, evidently depositing eggs there. These change quickly into maggots which may be seen with their heads thrust into the stigmata of the flowers of the wheat-plants. It is supposed by Köllar and some other entomologists that they live upon the pollen after it has been shed from the anthers, but Professor Henslow considers it more probable that they subsist upon the juices secreted in the ovary; and there can be no doubt that they do suck out the sap from this and the adjacent parts of the flower thereby hindering the perfect development of the grains. The prejudicial effect of this insect was first noticed in England by Mr C. Gullet, and described in the 'Philosophical Transactions' in 1772. Mr Marsham, the secretary of the Linnæan Society, investigated this subject in the 'Proceedings of the Linnæan Society' in 1796.

Very much injury is frequently occasioned by the *Cecidomyia tritici.* Curtis speaks of it as very destructive to wheat-crops as far back as 1828. Professor Henslow gives instances where ears of corn were found having only very few perfect grains within them, and he quotes Kirby as stating that in a certain field of wheat the loss was equal to a twentieth part of the crop. He also gives an instance of a third part of a crop being lost, in Perthshire. Other observers have found larvæ of these midges in almost every ear they have examined in certain fields. Mr C. S. Read, in his 'Report on the Farming of Oxfordshire' in the 'Journal of the Royal Agricultural Society,' says that in 1853 "the damage caused by the wheat-midge was something fearful." More recently it has been very destructive occasionally. In 1883 and 1884 it caused considerable losses in wheat-fields in various parts of the country, particularly in Gloucestershire, Wiltshire, and Kent. It is supposed that it was first introduced into this country in Kent, and that it came from France originally, where it is much dreaded. M. Herpin, a distinguished French entomologist, says that it is a native of France. M. Rendu describes it at some length in his 'Insectes Nuisibles à l'Agriculture,' under the head of 'La Cécidomie des blés.' Taschenberg says that it is well known to agriculturists as doing much harm to wheat-plants in Germany, while in America it is even more harmful than in England. Professor

Lintner remarks that steps have been taken in America for the importation of wheat-midge parasites from France in order to check this pest. It is gathered from various reports of entomologists to the Commissioners of Agriculture in Canada that the wheat-midge is often very troublesome in that country.

In the season of 1885, several complaints were sent as to injury from this insect, and many samples came to hand containing quantities of larvæ and showing serious damage. One sample of Square-head from Bedfordshire was especially affected. Samples of Velvet White and Red Lammas, from Kent and Hants, were also much affected. Miss Ormerod, among other affected samples, received one of Essex Wonder very full indeed of larvæ and imperfect grains, and relates that Golden Drop wheat-plants growing in an adjoining field were comparatively free from injury.

This midge is also found upon couch grass and upon other grasses in England as well as in France, in Germany, and America. Mr Carruthers, the consulting botanist of the Royal Agricultural Society of England, reports that he has found its larvæ in the heads of meadow foxtail, *Alopecurus pratensis*, to the considerable injury of the seed.

Life History. The perfect insect is of a pale yellowish colour, with 6 legs. Its wings are of a light yellow. It has a remarkably long ovipositor, and its antennæ are hairy. It appears first about the second week in June, and places its eggs in the ears in a somewhat remarkable manner as soon as they are put forth. The fly rests upon one of the florets of the ear and deposits its tiny yellow eggs within the sheaths or husks, hereafter to be chaff, of the corolla, and close to the embryonic grain, by means of a long tube projected from its body. The female lays from 10 to 20 eggs.

The larvæ appear in about 8 days. At first they are yellow. After a time they become more of an orange tint as they approach the pupa stage. At this time M. Rendu and M. Bazin state they have the power of springing to the ground from the ears, and Köllar says that they have powers of jumping ('Naturgeschichte der schadlichen Inseckten,' von V. Köllar). It is certain that the greater part of them get to the ground in some way, either by springing or falling down. They bury themselves about an inch in the soil and are then transformed into pupæ, in which state they remain until the end of April or the beginning of May, according to the circumstances of season and the general surroundings. Some of the late hatched larvæ remain in the ears of corn by the hardening of the chaff, in ripening. These are carried with the corn into ricks and barns and are thrashed out with the wheat, and if they are placed afterwards in suitable conditions they turn to pupæ and produce flies in due time. The larvæ have great vitality, and though they may seem to be quite dried up and dead, they will revive upon being placed in water. In 1881 upon taking in a wheat-stack enormous quantities of these larvæ were found in the chaff, and a good deal of the corn was thin and light. There must have been as many as 6 galls. of the larvæ in the box under the 'seed' sieve of the threshing machine. In the early summer numbers of tiny flies, or midges, may be seen hovering over any lumps of chaff, or 'cavings,' that may have been left in rick-yards or places where corn has been threshed in the fields. It is supposed that pairing takes place directly the flies come from the pupæ.

It has been thought by some entomologists that the *Cecidomyia* on first emerging from the pupa stage lays eggs in various grasses, and that it is the broods from these which infest the wheat. Though this has not been proved, it is most probable that two or more broods are produced in each season.

Prevention. The sole practical means of prevention is to cultivate the wheat-stubble, or 'gratten,' as it is called in Kent, directly the corn is carried, where the crop has been affected, so as to bury the larvæ deep in the ground. A dressing of hot lime might be applied with good results, but in this case the land should be very lightly scarified with one of Coleman's lightest scarifiers in order to bring the lime into close contact with the larvæ. After some days the land should be deeply ploughed to bury them and effectually prevent further transformation, at least to the imago form. Couch grass must be eradicated and hedge-sides and outsides of fields carefully brushed. It should be remarked here that brushing hedge-sides and all outsides, grassy roads, waste corners, and headlands should be done systematically—twice if possible, once early, before grasses seed and insects hatch out, and again in the autumn when insects are hibernating upon grasses and hedge-side and outside rubbish, either as perfect insects or in the egg stage. And it is of not much use merely to brush; the rubbish should be burnt or carried away to be mixened.

As a proportion of the larvæ in some seasons remain in the ears and are taken to the ricks and barns, it is most important that the chaff, after the corn is threshed and cleaned, which is not wanted for the horses, should be burnt or put in a mixen or under cattle in yards. The 'cavings' and rubbish from barn-floors, rick-staddles, and where the threshing machine has stood should be similarly treated. 'Cavings' and chaff should not be suffered to lie about in rick-yards and corners of fields, or at least not after March.

In Pennsylvania, Maine, Massachusetts, and other American States, after a bad attack of *Cecidomyia*, the farmers give up putting in winter wheat and sow spring wheat, which does not come into ear until after the flies have ceased to a great extent from troubling. But this would not answer in this country, as late sown spring wheat and wheat coming late into ear are not satisfactory, and spring wheat sown at the right time is not much later in flowering than winter-sown wheat. In Canada the farmers make large fires round corn fields to stifle the flies or to drive them from the neighbourhood.

Remedies. Under this head there is hardly any suggestion that can be made of any practical value. Agriculturists will see at once that it would be very difficult, if not almost impracticable, to apply lime or any such substance to check or kill the larvæ when the wheat plants are in ear. Even if they were applied, it is questioned whether they would be of much avail. Fortu-

nately, however, the *Cecidomyia,* like so many insects injurious to crops, has natural and relentless enemies. Two of these especially tend to diminish, and even entirely to stay its attacks in some years, viz. the *Platygaster tipulæ* and the *Macroglenes penetrans.* These are species of *Proctotrupidæ* and *Chalcididæ,* families of parasites which live on other insects. The first named of these lays its eggs within the eggs of the *Cecidomyia,* being enclosed in a very long thread-like tube 3 or 4 times its own length, which is projected from its abdomen for the purpose of reaching and penetrating the eggs of its victim lying within the florets of the ear. The other, *Macroglenes penetrans,* having a comparatively short ovipositor, puts its eggs within the bodies of the larvæ of the midges. The eggs soon change to larvæ, which make short work of the carcases of their hosts ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CECIDOMYIA CEREALIS. TIPULA CEREALIS, Sauter. The Barley-midge. This is another species of *Cecidomyia* peculiar to barley-plants, whose stems and leaves it attacks. It is larger than the *Cecidomyia tritici,* and of a reddish-brown colour. The larva is much larger and of a red colour. The same means of prevention are applicable as in the case of the *Cecidomyia tritici* ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CEDAR-WOOD (Oil of). See OILS.

Cedar-Wood (Tinctures of). See TINCTURES.

CE'DRAT. See LIQUEURS.

CE'DRENE and CE'DROLA. The oil of cedar-wood, by careful distillation, is separable into two substances—a solid crystalline compound (*cedrola*), and a volatile liquid hydrocarbon (*cedrene*). The first may be converted into the other by distillation with phosphoric anhydride.

CELLULARES. In *botany,* a name given to cryptogams, or flowerless plants, upon the supposition that they consist entirely of simple cells.

CEL'LULOSE. See LIGNIN.

CEMENT'. *Syn.* CEMENT'UM, L. Any substance which, when applied to the surfaces of other bodies, causes them to adhere together when placed in contact. Those referred to below are amongst the most useful preparations of this class. The term cement is also applied by builders and architects to several species of mortars and like compositions employed either to unite stones and bricks into masses, or as a protective covering against the weather or water, or to make statues, cornices, and similar ornamental articles.

In general the thinner the stratum of interposed cement, the stronger is the junction of the surfaces operated on. This caution is necessary, as in their anxiety to unite broken articles persons generally defeat themselves by spreading the cement too thickly on the edges of the fracture; whereas the least possible quantity should be used, so as to bring the edges as close as possible together.

Cement, Acid-proof. Melt india rubber by gentle heat, and stir into it 6% to 8% by weight of tallow, then add dry slaked lime to the consistency of a soft paste; lastly, 20% of red lead. This will resist boiling acids.

Cement, Al'abaster. 1. From plaster of Paris (in fine powder), made into a cream with water, and at once applied.

2. Yellow resin, 2 parts; melt and stir in plaster of Paris, 1 part.

3. Yellow resin, beeswax, and plaster of Paris, equal parts.

4. Resin, 8 parts; wax, 1 part; melt and stir in plaster of Paris, 4 parts, or q. s.

5. Sulphur or shell-lac, melted with sufficient plaster of Paris or colouring matter to give the desired shade. Used to join or mend pieces in alabaster, white marble, Derbyshire spar, porphyry, and other like substances; and to fill up cracks, supply chips out of corners, &c. The last four are applied hot, the surfaces to be united having previously been warmed. See CEMENT, WATERGLASS.

Cement, Architect'ural. 1. From paper (reduced to a smooth paste by boiling it in water), sifted whiting, and good size, equal parts, boiled to a proper consistence.

2. Paper paste, size, and plaster of Paris, equal parts; as before.

Obs. This is a species of papier-maché. It is used to make architectural ornaments, busts, statues, columns, &c. It is very light, and receives a good polish, but will not stand the weather unless it is well varnished or painted.

Cement, Arme'nian. *Syn.* DIAMOND CEMENT, PERSIAN C., TURKISH C., JEWELLERS' C. The jewellers of Turkey, who are mostly Armenians, have a singular method of ornamenting watch-cases, &c., with diamonds and other precious stones, by simply gluing or cementing them on. The stone is set in silver or gold, and the lower part of the metal made flat or to correspond with the part to which it is to be fixed; it is then gently warmed, and the glue is applied, which is so very strong that the parts thus cemented never separate. This glue will strongly unite pieces of glass and china, and even polished steel, and may be applied to a variety of useful purposes.

Prep. 1. (Original Armenian formula; *Eton.*) Dissolve 5 or 6 bits of gum-mastic, each the size of a large pea, in as much rectified spirit of wine as will suffice to render it liquid; and, in another vessel, dissolve as much isinglass, previously a little softened in water (though none of the water must be used), in French brandy or good rum, as will make a 2-oz. phial of very strong glue, adding two small bits of gum-galbanum or ammoniacum which must be rubbed or ground till they are dissolved. Then mix the whole with a sufficient heat. Keep the glue in a phial closely stopped, and when it is to be used set the phial in boiling water.

2. (*Keller's* ARMENIAN CEMENT.) Soak isinglass, ½ oz., in water, 4 oz., for 24 hours; evaporate in a water-bath to 2 oz.; add rectified spirit, 2 oz.; and strain through linen; mix this, whilst warm, with a solution formed by dissolving gum-mastic (best), ¼ oz., in rectified spirit, 2 oz.; add of powdered gum-ammoniac, 1 dr., and triturate together until perfectly incorporated, avoiding loss of the spirit by evaporation as much as possible.

3. (*Ure's* DIAMOND CEMENT.) Isinglass, 1 oz.; distilled water, 6 oz.; boil to 3 oz., and add

rectified spirit, $1\frac{1}{2}$ oz.; boil for a minute or two, strain, and add, while hot, first a milky emulsion of ammoniac, $\frac{1}{2}$ oz., and then tincture of mastic, 5 dr.

4. Isinglass soaked in water and dissolved in spirit, 2 oz. (thick); dissolve in this 10 gr. of very pale gum-ammoniac (in tears), by rubbing them together; then add 6 large tears of gum-mastic, dissolved in the least possible quantity of rectified spirit.

5. Isinglass dissolved in proof spirit (as *above*), 3 oz.; bottoms of mastic varnish (thick but clear), $1\frac{1}{2}$ oz.; mix well.

Obs. When carefully made, this cement resists moisture and dries colourless. As usually met with, it is not only of very bad quality, but sold at exorbitant prices. "Some persons have sold a composition under the name of Armenian cement in England; but this composition is badly made; it is much too thin, and the quantity of mastic is much too small" (*Eton*). Methylated spirit may be used instead of the pure spirit in the above preparations. Mastic and mastic varnish are also used by jewellers as cements.

Cement, Beale's. Chalk, 60 parts; lime and salt, of each, 20 parts; Barnsey sand, 10 parts; iron filings or dust, and blue or red clay, of each, 5 parts; grind together and calcine. Patented as a fire-proof cement.

Cement for Bicycle Tires. Melt 2 parts of asphalt and 1 part of gutta percha together in an iron crucible. When quite hot apply to the wheel, which must also be hot, then slip on the tire.

Cement, Boil′er. *Prep.* Dried clay in powder, 6 lb.; iron filings, 1 lb. Make into a paste with boiled linseed oil. Used to stop cracks and leaks in iron boilers, stoves, &c. See CEMENT, IRON, STEAM-BOILER C.

Cement, Bot′any Bay. Yellow gum (Botany Bay gum) and brickdust, equal parts, melted together. Used to cement coarse earthenware, &c.

Cement, Bot′tle. *Prep.* 1. Resin, 1 lb.; tallow or suet, $\frac{1}{4}$ lb.; melt together, and stir in the colouring matter.

3. Resin, 5 lbs.; beeswax, 1 lb.; colouring, q. s.; as last.

3. (Red.) To each lb. of the above add whiting (dry), 3 oz., and light red (burnt) ochre, 4 oz.; or red bole, q. s. (all in fine powder).

4. (Black.) *a.* To each lb. of No. 1 or No. 2, add ivory-black (bone-black), q. s.

b. From black pitch, 6 lb.; ivory-black and whiting, of each, 1 lb.; melted together. Used in the same way as common sealing-wax for bottle corks, cask-bungs, &c. See CEMENT, MAISSIAT'S.

Cement, Brim′stone. Melted brimstone, either alone or mixed with resin and brickdust. Cheap and useful.

Cement, Bru′yere's. Clay, 3 parts; slaked lime, 1 part; mix and expose them to a full red heat for 3 hours, then grind to powder. Recommended as an hydraulic cement.

Cement, Build′ing. *Syn.* ARTIFICIAL PUZZOLANA. From a mixture of clay or loam, broken pottery, flints, or siliceous sand, or broken bottle glass, and wood ashes, exposed to a considerable heat in a furnace, until it becomes partially vitrified; it is then ground to fine powder, sifted, and mixed with 1-3rd its weight of quicklime, also in fine powder, after which it must be packed (tight) in casks to preserve it from the air and moisture. For use it is mixed up with water and applied like Roman cement.

Cement, Cap. *Prep.* 1. Resin, 5 lbs.; beeswax and dried Venetian red, of each, 1 lb.; melted together.

2. (*C. G. Williams.*) Equal weights of red-lead and white-lead. Used for chemical and electrical purposes. For cementing glass tubes, necks of balloons, &c., into metal mountings. No. 2 is preferable to white-lead alone, and may be depended on for temperature up to 212°.

Cement, Cheese. From grated cheese, 2 parts; quicklime (in fine powder), 1 part; white of egg, q. s.; beat to a paste. Used for earthenware, &c.

Cement, Chem′ical. *Syn.* SOFT CEMENT. *Prep.* From yellow wax, 4 parts; common turpentine, 2 parts; Venetian red (well dried), 1 part; melted together. Used as a temporary stopping or lute for the ends or joints of tubes which are not exposed to much heat, as in alkalimetry, &c. See CEMENT, ELECTRICAL.

Cement, Chinese. *Syn.* SHELL-LAC CEMENT, LIQUID GLUE. *Prep.* 1. Finest pale orange shell-lac (broken small), 4 oz.; rectified spirit (strongest), 3 oz.; digested together in a corked bottle in a warm place until dissolved. Very strong and useful; almost odourless. It should have about the consistence of treacle.

2. As before, but using rectified wood naphtha as the solvent. Inferior to the last, but excellent for many purposes.

3. (Without spirit.) *Prep.* Borax, 1 oz.; water, $\frac{3}{4}$ pint; shell-lac, 3 oz.; boil in a covered vessel until dissolved, then evaporate to a proper consistence. Cheap and useful, but dries slowly.

4. Macerate for several hours 6 parts of glue, in small pieces, in 16 parts of water; then add 1 part of hydrochloric acid, and $1\frac{1}{2}$ parts of sulphate of zinc; let the mixture be kept for 10 or 12 hours at a temperature of 68° or 70° C.

Uses, &c. Employed to mend glass, china, fancywork, jewellery, &c., for which it is only inferior to Armenian cement. The first formula produces a cement so strong that pieces of wood may be joined together, cut slopingly across the grain, and will afterwards resist every attempt to break them at the same place. In many of the islands of the Indian Ocean, in Japan, China, and the East Indies, a similar cement is used to join pieces of wood for bows, lances, &c. The fluid is thinly smeared over each face of the joint, a piece of very thin gauze interposed, and the whole pressed tightly together and maintained so until the next day. Joints so made will even bear the continual flexure of a bow without separating. It is admirably adapted for fishing-rods. The product of the second formula is commonly sold as LIQUID GLUE. That of the last is much used by the druggists and oilmen, instead of gum, for fixing paper labels to tin, and to glass when exposed to damp.

Cement, Coppersmiths'. *Syn.* BLOOD CEMENT. From bullocks' blood thickened with finely powdered quicklime. Used to secure the edges and

rivets of copper boilers, to mend leaks from joints, &c. It must be used as soon as mixed, as it rapidly gets hard. It is cheap and durable, and is suited for many other purposes.

Cement, Curd. *Prep.* 1. The curd of skimmed milk (obtained by the addition of vinegar or rennet) is beaten to a paste with quicklime, in fine powder.

2. Add vinegar, ½ pint, to skimmed milk, ½ pint; mix the curd with the whites of 5 eggs; well beaten and powdered quicklime, q. s. to form a paste. Used for mending glass and earthenware; they resist water and a moderate degree of heat.

3. Rub from 2 to 4 parts of the curd with a cold solution of borax till a thick liquid is obtained that becomes clear on standing. This is an excellent cement for artificial meerschaums, and may be used to give consistency to silk goods or to coat artificial flowers, and court-plaster, to the latter of which it imparts more adhesiveness and firmness.

Cement, Cutler's. *Prep.* 1. Black resin, 4 lbs; beeswax, 1 lb.; melt, and add finely powdered and well-dried brickdust, 1 lb.; mix well.

2. Equal weights of resin and brickdust, melted together.

Use. To fix knives and forks in their handles. It is put into the hollow of the handle, and the metal, previously made hot enough to melt the composition, pressed into its place whilst warm, and the whole kept upright and still until quite cold.

Cement, Di'amond. See Cement, Armenian.

Cement, Egg. White of egg thickened with finely powdered quicklime. Used to mend earthenware, glass, china, marble, alabaster, spar ornaments, &c. It does not resist long exposure to moisture unless it has been exposed to heat.

Cement, Elas'tic. *Prep.* 1. Caoutchouc (in small pieces), 1 part; chloroform, 3 parts; dissolve.

2. (*Lenher.*) Caoutchouc, 5 parts; chloroform, 3 parts; dissolve, and add gum-mastic (powdered), 1 part. Elastic and transparent.

3. Gutta percha, 3 parts; caoutchouc, 1 part (both cut small); bisulphide of carbon, 8 parts; mix in a close vessel and dissolve by the heat of a water-bath. This is to be gently warmed before it is applied.

4. Gutta percha, 1 lb.; caoutchouc, 4 oz.; pitch, 2 oz.; shell-lac, 1 oz.; linseed oil, 2 oz.; melted together. This must be melted before being applied.

Obs. The cements 1 and 2 are elastic and transparent, and are applicable to many uses. The others, 3 and 4, are used for uniting leather, cloth, &c.

Cement, Elec'trical. *Syn.* Chemical cement. From black resin, 7 lbs.; red ochre, 1 lb.; plaster of Paris, ½ lb. (both well dried and still warm); melted together, and the heat and agitation continued until all frothing ceases, and the liquid runs smooth; the vessel is then withdrawn from the fire, and the mixture stirred until cooled sufficiently. Used to cement the plates in galvanic troughs, join chemical vessels, &c. See Cement, Cap; Cement, Singer's, &c.

Cement, Engineers'. *Prep.* 1. Ground white-lead, mixed with as much red-lead as will make it of the consistence of putty.

2. Equal weights of red-lead and white-lead, mixed with boiled linseed oil, to a proper consistence. Used by engineers and others to make metallic joints. A washer of hemp, yarn, or canvas, smeared with the cement, is placed in the joint, which is then 'brought home,' or screwed up tight. It dries as hard as stone. It also answers well for joining broken stones, however large. Cisterns built of square stones, put together while dry, with this cement, will never leak or come to repair.

Cement, Extempora''neous. 1. Shell-lac, melted, and run into small sticks the size of a quill. Used to join glass, earthenware, &c. The edges are heated sufficiently hot to melt the cement, which is then thinly smeared over them, and the joint made while they are still hot. This is the cement so commonly vended in the streets of London, and which used to surprise us in our boyhood days.

2. Tears of gum-mastic, used in the same way. Commonly employed by jewellers and others.

Cement, Fire'proof. *Prep.* From fine river sand, 20 parts; litharge, 2 parts; quicklime, 1 part; linseed oil, q. s to form a thin paste. Applied to walls, it soon acquires a stony hardness. It is also used to mend broken pieces of stone, stone steps, &c. See Cement, Beale's, &c.

Cement Floor Laying. The foundation should be rammed solid; if any filling is required, it should be done with hard dry material, and no lime rubbish should be in it, as this has a tendency to swell, and lift the floor; a covering of broken stones to pass through a 2-inch ring not less than 3 inches thick should be laid over the floor, leaving 2 inches or more, if required, for the concrete. The concrete is mixed with 5½ cwt. of Portland cement to 1 ton of crushed bricks, limestone, or slag that will pass through a 2-inch mesh. It must be well mixed, wetted, and turned over twice, then laid on the broken stones, and levelled by means of a straight-edge from pegs, or a board laid level at each side. It must also be well beaten down with a hand beater about 15 inches by 10 inches with a handle on the back, till quite level and fluid on the top; it is then left for a few hours till nearly stiff, when it is smoothed over with a plasterer's trowel. If laid outside as footpaths, it should be in squares not more than 6 feet, or it will crack; the harder and more solid the foundation is the less likely is it to crack. The quantity named will lay about 14 or 15 super. yards.

Cement, Flour. *Syn.* Paste, Flour paste. This useful and well-known article is made by mixing about a tablespoonful of wheat-flour with cold water, (say) ½ pint, adding the latter gradually, and thoroughly stirring in each portion before pouring in more; the vessel is then placed over the fire, and the whole assiduously stirred until it boils, great care being taken to prevent caking on the bottom, or burning. Some persons add about 1-3rd of a teaspoonful of powdered alum to the water, which is said to strengthen the product; the shoemakers add a little quantity of powdered resin to the flour, with the same

intention. The addition of a little brown sugar and a few grains of corrosive sublimate will prevent it turning mouldy, and is said to preserve it for years. When too hard or dry, it may be softened by beating it up with a little hot water.

Cement, French. Mucilage of gum-arabic, thickened with starch powder or farina; a little lemon-juice is sometimes added. Used by naturalists in mounting specimens; by artificial-flower makers; and by confectioners to stick paper, wafer-papers, ornaments, &c., on their fancy cakes. Plain mucilage is often used in the same way.

Cement, Gad's. *Syn.* GAD'S HYDRAULIC CEMENT. From clay (well dried and powdered), 3 parts; oxide of iron, 1 part; mixed together, and made into a stiff paste with boiled oil. Used for work required to harden under water.

Cement, Gibbs'. Mr Gibbs patented, in 1850, various processes for making admirable building and architectural cements, equal in hardness and duration, and superior in colour, to the best Roman and Portland cements at present in use. His materials are obtained from "the vast beds of (natural) argillaceous marls and marly limestones, or marlstones, which contain the due admixture of lime, silica, and alumina, from which hydraulic cements and artificial stones may be manufactured." These materials he finds in "the chalk formation, the Wealden formation, the Purbeck beds, the lias formation, the mountain limestone, and the lowest strata of the coal-measures." After duly choosing his materials according to the particular object in view, he prepares them "by burning in kilns, and grinding in mills, in the way cement is now manufactured." Marls and limestones are to be "first dried in kilns or ovens, at a heat fit for baking, until all moisture be driven off, and then the calcination prolonged as much as possible; the heat being kept as low as is only just sufficient to effect complete calcination—this being indispensable, to avoid the commencement of vitrification, which would destroy the adhesive properties of the cement."

Cement, Glass. *Syn.* GLASS FLUX. *Prep.* Red-lead, 3 parts; fine white sand, 2 parts; crystallised boracic acid, 3 parts; mixed and fused; it is levigated, and applied with thin mucilage of tragacanth. Used for mending broken china, &c. The repaired article must be gently heated, so as partially to fuse the cement.

Cement for Connecting Glass and Brass. According to Puscher, a cement of the kind which stands heat very well and which is not dissolved by petroleum, and is therefore very adaptable for cementing the brass burners on the glass reservoirs of petroleum lamps, is made by boiling 1 part of caustic soda and 3 parts of colophony with 5 parts of water, and kneading up the resin soap thus formed with half its weight of gypsum. Thus prepared, the cement hardens within about three-quarters of an hour. If zinc-white or white lead is used in the place of gypsum the hardening takes place more slowly.

Cement, Glue. *Prep.* 1. From glue, 1 lb. melted with the least possible quantity of water, and then mixed with black resin, 1 lb., and red ochre, 4 oz.

2. Glue, melted as above, and mixed with about 1-4th of its weight each of boiled oil and red ochre.

3. (*Ure.*) Melted glue (of the consistence used by carpenters), 8 parts; linseed oil, boiled to varnish with litharge, 4 parts; incorporate thoroughly together.

4. Glue (melted as last), 4 parts; Venice turpentine, 1 part.

Obs. The first three dry in about 48 hours, and are very useful to render the joints of wooden casks, cisterns, &c., watertight; also to fix stones in frames. The last serves to cement glass, wood, and even metal to each other. A good cement for fixing wood to glass may be made by dissolving isinglass in acetic acid, in such quantities that it becomes solid when cold. When applied let it be heated. They all resist moisture well.

Cement, Grind'ers'. *Prep.* 1. From pitch, 5 parts; wood ashes and hard tallow, of each, 1 part; melted together.

2. Black resin, 4 lbs.; beeswax, 1 lb.; melt and add of whiting (previously heated red-hot and still warm), 1 lb.

3. Shell-lac, melted and applied to the pieces slightly heated. Used to fix pieces of glass, &c., whilst grinding. The last is used for lenses and fine work.

Cement, Hamelin's. *Syn.* HAMELIN'S MASTIC. From siliceous sand, 60 parts; Bath or Portland stone (in fine powder), 40 parts; lime-marl, 20 parts; litharge, 8 parts; ground together. For use it is mixed up with linseed oil, and used like mortar. When this cement is applied to the purpose of covering buildings intended to resemble stone, the surface of the building is first washed with linseed oil.

Cement, Hensler's. Litharge, 3 parts; quick-lime, 2 parts; white-bole, 1 part (all in fine powder); linseed-oil varnish, q. s. to make a paste. Used for china, glass, &c. It is very tenacious, but long in drying.

Cement, Hœnler's. Shell-lac, 2 parts; Venice turpentine, 1 part; fused together, and formed into sticks. It is used like extemporaneous cement for glass and earthenware.

Cement, Hydraulic. Hydraulic mortars or cements are those which set or become hard under water. Common lime does not possess this property; but limestone containing from 8 % to 25 % of alumina, magnesia, and silica, yield a lime on burning which does not slake when moistened with water, but forms a mortar with it, which hardens in a few days when covered with water, although it does not acquire much solidity in the air. Pozzolana, septaria, and argillaceous or siliceous earths, burnt, either with or without the addition of common limestone, and then ground to powder, form excellent hydraulic cements. The reniform limestone, commonly called 'cement stone,' which is found distributed in single nodules or lenticular cakes, in beds of clay, is the substance most commonly used in this country for the manufacture of the cements in question.

"A very good hydraulic mortar is made by slaking lime with water containing about 2% of gypsum, and adding a little sand to the product. The presence of the gypsum tends to delay the

slaking of the lime, and also to harden the substance formed after the slaking.

"If water containing a little lime in solution be added to burnt gypsum, a very hard compact mass is obtained. This substance is much used as an imitation marble, as by polishing it with pumice stone, colouring it, and again polishing with oil, it may be made to resemble natural marble very closely. Hardened gypsum treated with stearic acid, or paraffin, and polished, is used as a substitute for meerschaum, which it much resembles" ('Chemistry, Theoretical, Practical, and Analytical'). See GAD'S, HAMELIN'S, and PARKER'S CEMENTS, &c.

Cement, Iron. This cement, which is much used for closing the joints of iron pipes and similar purposes, is formed of the borings or turnings of cast-iron, which should be clean and free from rust, mixed with a small quantity of sal-ammoniac and flowers of sulphur. For use, it is stirred up with just enough water to thoroughly moisten it, and it is rammed or caulked into the joints with a blunt caulking chisel and hammer, after which the joint is screwed up by its bolts as tightly as possible. If the turnings and borings are very coarse they are broken by pounding in an iron mortar, and the dust sifted off before use. The following are good proportions:

1. Sal-ammoniac (in powder), 2 oz.; flowers of sulphur, 1 oz,; iron borings, 5 lbs.; water, q. s. to mix.

2. Sal-ammoniac, 2 oz.; sulphur, 1 oz.; iron borings, 12 lbs.; water, q. s. to mix.

3. Sal-ammoniac, 2 oz.; iron borings, 7 or 8 lbs.; water, q. s. to mix.

4. Iron borings, 4 lbs.; good pipeclay, 2 lbs.; powdered potsherds, 1 lb.; make them into a paste with salt and water.

Remarks. The first of these forms is that generally employed for common purposes, but formerly much more sulphur and sal-ammoniac were used. We are told by one of the leading engineers in London that the strongest cement is made without sulphur and with only 1 or 2 parts of sal-ammoniac to 100 of iron borings (see the third form); but that when the work is required to dry rapidly, as for the steam joints of machinery wanted in haste, the quantity of sal-ammoniac is increased a little, and a very small quantity of sulphur is added. This addition makes it set quicker, but reduces its strength. As the power of the cement depends on the oxidation and consequent expansion of the mass, it is evident that the less foreign matter introduced the better. No more of this cement should be made at a time than can be used at once, because it soon spoils. I have seen it become quite hot by standing even a few hours when it contained sulphur; and I have been informed by workmen that when much sulphur is used, and it has been left together in quantity all night, combustion has taken place. The last form produces a cement that gets very hard when allowed to dry slowly, and is excellent for mending cracks in iron boilers, tanks, &c.

Cement, Japanese. *Syn.* RICE GLUE. From rice-flour mixed with a little cold water, and boiling water gradually poured in until it acquires a proper consistence, when it is boiled for 1 or 2 minutes in a clean saucepan or earthen pipkin. It is beautifully white, and almost transparent, for which reason it is well adapted for fancy paper work, which requires a strong and colourless cement. It is superior to French cement (see *antè*).

Cement, Keene's Marble. Baked gypsum or plaster of Paris, steeped in a saturated solution of alum, and then recalcined and reduced to powder. For use it is mixed up with water, as ordinary plaster of Paris.

Obs. This cement has been most extensively applied as a stucco. It is susceptible of a high polish, and when coloured produces beautiful imitations of mosaic and other inlaid marbles, scagliola, &c. It is not adapted to hydraulic purposes or for exposure to the weather, but it is admirable for internal decorations, and from its extreme hardness is very durable. It may be coloured or tinted of any shade by diffusing mineral colours (levigated if in powder) through the water used to mix up the cement with. A pleasing tint is given to this cement by adding a little solution of green copperas to the alum liquor.

Cement, Laboratory. *Syn.* CHEMICAL MASTIC. From equal parts of pitch, resin, and plaster of Paris (thoroughly dried), mixed together. Used for the masonry of chlorine chambers, vitriol works, &c.; and as a lining for casks intended to hold chloride of lime.

Cement for Leather or Cloth. Gutta percha, 1 lb.; india rubber, 4 oz.; pitch, 2 oz.; shell-lac, 1 oz.; oil, 2 oz.; melt together and use hot. Gutta percha dissolved in carbon disulphide makes an excellent cement for leather; it should have the consistency of treacle.

Cement, Letter-fixing. *Prep.* Copal varnish, 15 parts; drying oil, 5 parts; turpentine, 3 parts; oil of turpentine, 2 parts; liquefied glue (made with the least possible quantity of water), 5 parts; melt together in a water-bath, and add fresh slaked lime (perfectly dry, and in very fine powder), 10 parts. Used to attach metal letters to plate glass in shop windows, &c.

Cement, Mahogany. *Prep.* 1. Melt beeswax, 4 oz.; then add Indian red, 1 oz., and enough yellow ochre to produce the required tint.

2. Shell-lac, melted and coloured as above. Very hard. Both are used to fill up holes and cracks in mahogany furniture by the cabinet-makers. Red putty is also used for the same purpose.

Cement, Maissiat's. India rubber is melted either with or without about 15% of either beeswax or tallow; quicklime (in fine powder) is gradually added; and the heat continued until change of odour shows that combination has taken place, and until a proper consistence is obtained. Used as a waterproof and air-tight covering for corks, bungs, &c.

Cement, Marine. See GLUE, MARINE, and CEMENT, ELASTIC.

Cement, Martin's. This is manufactured in the same way as Keene's, only carbonate of soda or carbonate of potash is used as well as alum, and the burning is carried on at a higher temperature.

Cement, Opticians'. *Prep.* 1. Shell-lac softened with rectified spirit or wood naphtha. For fine work.

2. Beeswax, 1 oz.; resin, 15 oz.; melt and add whiting (previously made red-hot, and still warm), 4 oz.

3. Resin, 1 lb.; melt and add plaster of Paris (dry), 4 oz. The above are used to fix glasses, stones, &c., while polishing and cutting them. The last is a very strong cement for rough purposes.

Cement, Oxychlo″ride of Zinc. (*Sorel.*) *Prep.* In solution of chloride of zinc, marking from 50°—60° of Baumé's hydrometer (*i. e.* sp. gr. 1·490 to 1·652), dissolve 3% of borax or sal-ammoniac; then add oxide of zinc which has been heated to redness, until the mass is of a proper consistence.

Obs. This cement becomes as hard as marble. It may be cast in moulds like plaster of Paris, or used in mosaic work, &c.

Cement, Parabol′ic. *Syn.* UNIVERSAL CEMENT. *Prep.* Curdle skim milk with rennet or vinegar, press out the whey, and dry the curd by a very gentle heat, but as quickly as possible. When it has become quite dry grind it in a coffee or pepper mill, and next triturate it in a mortar until reduced to a very fine powder. Mix this powder with 1-10th of its weight of new dry quicklime, also in very fine powder, and to every ounce of the mixture add 5 or 6 gr. of powdered camphor; triturate the whole well together, and keep it in wide-mouth 1-oz. phials, well corked. Used to join glass, earthenware, &c. It is made into a paste with a little water, as wanted, and applied immediately.

Cement, Parian. Is prepared as Keene's, substituting a solution of borax (1 part of borax to 9 of water) for a solution of alum.

Cement, Park′er's. This cement is made of the nodules of indurated and slightly ferruginous marl, called by mineralogists 'septaria,' and also of some other species of argillaceous limestone. These are burnt in conical kilns, with pit coal, in a similar way to other limestone, care being taken to avoid the use of too much heat, as if the pieces undergo the slightest degree of fusion, even on the surface, they will be unfit to form the cement. After being properly roasted the calx is reduced to a very fine powder by grinding, and immediately packed in barrels, to keep it from the air and moisture.

Uses, &c. This cement is tempered with water, and applied at once, as it soon hardens, and will not bear being again softened down with water. For foundations and cornices exposed to the weather it is usually mixed with an equal quantity of clean angular sand; for use as a common mortar, with about twice as much sand; for coating walls exposed to cold and wet, the common proportions are 3 of sand to 2 of cement; and for walls exposed to extreme dryness or heat, about 2½ or 3 of sand to 1 of cement; for facing cistern work, water frontages, &c., nothing but cement and water should be employed. Under the name of compo' or Roman cement it is much employed for facing houses, water cisterns, setting the foundations of large edifices, &c.

Cement, Pew's. Quick-lime, 1 part; baked clay, 2 parts (both in powder); mix and calcine; then add gypsum (fresh baked and in fine powder), 1 part, to powdered baked clay, 2 parts; mix well, add the former mixture, and incorporate them well together. Used to cover buildings. It is applied like mortar, and is very hard and durable. See CEMENT, GIBBS', &c.

Cement, Plumb′ers'. Black resin melted with about an equal weight of brick-dust. Sometimes a little pitch or tallow is added.

Cement, Port′land. From clay and chalk, or argillaceous river-mud and chalk or limestone, calcined together, and then ground to powder. See CEMENT, PARKER'S.

Cement, Ro′man. Genuine Roman cement consists of pozzolana (volcanic sand), lime, and sand. The only preparation which the pozzolana undergoes is that of pounding and sifting. It is generally mixed up with water, like most other cements, but occasionally with bullocks' blood and oil, to give the composition more tenacity. That used in this country is now generally prepared from the septaria of either Harwich or Sheppy, or of the lias formation, or from the cement stone found in the upper division of the lias formation, or in the shale beds of the Kimmeridge clay. It is also prepared from several artificial mixtures of ferruginous clay and lime, calcined together. It must be kept in close vessels, and mixed with water when used. See CEMENT, PARKER'S and GIBBS'.

Cement, for Rubber and Metal. Dissolve pulverised shell-lac in 10 times its weight of pure ammonia; allow to stand for 3 days before use. This will fasten rubber to metal very securely.

Cement, Seal Engra″vers'. Resembles plumbers' cement. Used to fix the pieces of metal while cutting, and also to secure seals and tools in their handles. It grows harder and improves every times it is melted.

Cement, Sin′ger's. *Prep.* 1. Melt together resin, 5 lbs., and beeswax, 1 lb., and stir in finely-powdered red ochre (highly dried and still warm), 1 lb., and plaster of Paris, 4 oz.; continuing the heat a little above 212° F., and stirring constantly till all frothing ceases.

2. Resin, 6 lbs.; dried red ochre, 1 lb.; calcined plaster of Paris, ½ lb.; linseed oil, ¼ lb. Used to cement the plates in voltaic troughs, to join chemical vessels, &c. No. 2 is specially applicable to troughs. See CEMENT, ELECTRICAL.

Cement, Steam-boiler. *Prep.* Litharge, in fine powder, 2 parts; very fine sand and quicklime (that has been allowed to slake spontaneously in a damp place), of each, 1 part; mix and keep it from the air. Used to mend the cracks in boilers and ovens, and to secure steam joints. It is made into a paste with boiled oil before application.

Cement, Steam-pipe. *Prep.* Good linseed oil varnish is ground with equal weights of white lead, oxide of manganese, and pipeclay.

Cement, Stucco. This is a compound of powdered gypsum and strong gelatin. It is used for coating walls, and also for ornamenting ceilings. It takes a high polish, and coloured designs can be painted on it. When employed on walls a coarser kind is first laid on, which is followed by a coating made of choicer specimens of gypsum, or glue, or isinglass. When this latter and outer coat becomes dry it is polished with pumice, tripoli, and linen. The colour is incorporated with the outer coatings of the stucco by

mixing the metallic pigments with it, and then applying it to the wall, after which a very thin coating of gypsum and isinglass, or sometimes of oil, is given to it, and when the whole is partially dried the tint is brought out by polishing, as before stated. Generally the finest effect is obtained by oil.

Cement, Transpar'ent. See CEMENT, ELASTIC.

Cement, Turn'ers'. *Prep.* Beeswax, 1 oz.; resin, $\frac{1}{2}$ oz.; pitch, $\frac{1}{2}$ oz.; melt, and stir in fine brickdust, q. s.

Cement, Univers'al. See CEMENT, PARABOLIC.

Cement, Var'ley's. *Syn.* VARLEY'S MASTIC. Black resin, 16 parts; beeswax, 1 part; melt, add whiting (sifted, dried by a dull red heat, and allowed to cool), 16 parts; and stir until nearly cold.

Cement, Water. *Prep.* 1. From good grey clay, 4 parts; black oxide of manganese, 6 parts; limestone (reduced to powder by sprinkling it with water), 90 parts; mix, calcine, and powder.

2. Mix white iron ore (manganese iron ore), 15 parts, with lime, 85 parts; calcine and powder as above. Both this and the preceding must be mixed up with a little sand for use. A piece thrown into water rapidly hardens.

3. Fine clean sand, 1 cwt.; quicklime, in powder, 28 lbs.; bone ashes, 14 lbs. The above are beat up with water for use. See CEMENT, HYDRAULIC, &c.

Cement, Waterglass. For glass, earthenware, porcelain, and all kinds of stoneware, these cements are excellent. A cement for glass and marble is prepared by rubbing together 1 part of fine pulverised glass, and 2 parts of pulverised fluorspar, and then adding enough waterglass solution to give it the consistency necessary in a cement.

Waterglass mixed with hydraulic cement to a thick dough makes a good cement for the edges and joints of stone and marble slabs. It is well to mix but little at a time, as it hardens very quickly ('Journal of Applied Chemistry').

Cement, Wa'terproof. Several compounds of this class have been already noticed. The celebrated 'waterproof cement of Dihl' consists of porcelain clay or pipeclay, dried by a gentle heat, and powdered, mixed up to the consistence of a paste with boiled linseed oil, and, sometimes, a little oil of turpentine. It is coloured by adding a little red or yellow ochre, or any similar pigment. It is used to cover the fronts of buildings, roofs of verandahs, &c.

Concluding Remarks. For mending broken CHINA, EARTHENWARE, GLASS, and WOOD, the preparations generally used are the cements described above as ARMENIAN, BOTANY BAY, CHEESE, CHINESE, CURD, EGG, EXTEMPORANEOUS, GLASS, HENSLER'S, HŒNLE'S, MAHOGANY, and PARABOLIC. For SPAR, MARBLE, and similar materials, the ALABASTER CEMENT is specially adapted; the EGG and PARABOLIC CEMENTS will, however, answer the same purpose. For CLOTH, LEATHER, PAPER, CARD, and LIGHT FANCY WORK, the most suitable cements are the ELASTIC, CHINESE, FLOUR, FRENCH, and JAPANESE. The cements adapted for CHEMICAL and ELECTRICAL APPARATUS, and for SEALING BOTTLES, are also termed BOTTLE, BRIMSTONE, CAP, CHEMICAL, ELECTRICAL, LABORATORY, MAISSIAT'S, and VARLEY'S. The BUILDING and HYDRAULIC CEMENTS are described under the heads ARCHITECTURAL, BEALE'S, BRUYERE'S, FIREPROOF, GAD'S, GIBBS', HAMELIN'S, HYDRAULIC, KEENE'S, OXYCHLORIDE, PARKER'S, PEW'S, PORTLAND, ROMAN, WATER, and WATERPROOF. The cements used for METAL-WORK, &c., in different trades, are noticed under the heads COPPERSMITHS', CUTLERS', ENGINEERS', GRINDERS', IRON, LETTER-FIXING, OPTICIANS', PLUMBERS', SEAL-ENGRAVERS', STEAM-BOILER, STEAM-PIPE, and TURNER'S. See GLUE, LUTE, MORTAR, TOOTH-CEMENT, &c.

CEMENTA'TION. The process of imbedding a substance in, or covering it with, some powder or composition capable of acting on it when heated, and in this state exposing it to a red heat. Iron is converted into steel, and glass into Réaumur's porcelain, by cementation.

CEN'TAURIN. *Syn.* CENTAURIN'A. The bitter extractive matter of *Erythæa centaurium*, or common centaury. Combined with hydrochloric acids, it has been highly recommended as a febrifuge.

CEPHUS PYGMÆUS, Curtis. The Corn Saw-fly. This is one of the very numerous species of the family of *Tenthredinidæ*, or saw-flies, of the Nat. Ord. HYMENOPTERA. Many of these species are most destructive to farm-crops—corn, turnips, grasses, fruit trees—and to forest trees. This species, *Cephus pygmæus*, or rather its larva, lives within the stems of wheat, and other corn-plants more rarely, and sometimes it gives rise to considerable mischief. It is said by Curtis that it occasionally attacks rye-plants very seriously. French and German entomologists report that this *Cephus* is destructive both to rye and wheat-plants, not infrequently causing the loss of a fiftieth or even a sixtieth part of the crop.

Grave complaints of injuries were made to me from Gloucestershire, Cheshire, and Worcestershire, in 1883 and 1884. It was mentioned that in several wheat-fields from 20% to 30% of the stems had become yellow, not yellow as of ripening straw, but a pale sickly yellow, while the other plants had not begun to change, and would not in the natural course change colour for some time. Several stems were sent for examination. The ears of these had no signs of grains in them. Upon cutting down these stems it was discovered that the knots or joints had all been bored or pierced through, and the inner membranous substance of the stem had plainly been eaten away, which had made the stem prematurely blanched or etiolated. Near the foot-stalks legless, or apparently legless, maggots were found nearly white, but in some cases rather inclining to cream colour. Later on more specimens of affected corn-stems were sent; in these it was seen that the stem had been cut round just above the ground, and the farmers who forwarded them said that much of the straw had broken off at the base of the stalk and was lying upon the ground, and that the fields looked as if a flock of sheep or other animals had been driven through them, because so much of the straw was broken and lying on the ground. Various accounts of similar damage have been sent from time to time. For-

tunately the injuries of this insect have not hitherto been very generally extensive.

Life History. This *Cephus pygmæus* in its perfect form presents the appearance of a tiny wasp. Its body is nearly black. The legs of male are chiefly yellow. Those of the female are ochreous with thighs black, except at their upper parts, and feet mainly brown. The wings are transparent, with dark articulations. About a dozen eggs are laid by each female, which deposits them singly in the stems of the plants, not far from the forming ear, whose situation is calculated with wonderful instinct. To effect this tiny slits are made in the outer cuticle of the stem by means of a wonderful apparatus consisting of a double set of saws like carpenters' fine saws, as they have been described by Professor Westwood, with which the abdomen of the female is furnished. When the slit has been made the ovipositor is inserted, so that the egg is thrust deeply into the inner membrane of the stem. After 10 days the larva appears. It is of a white, or creamy white shade of colour, shaped like a caterpillar, having upon microscopical investigation six most rudimentary thoracic feet. In this respect this genus differs from other saw-flies, whose larvæ are furnished with many feet. It has very strong jaws adapted for biting; with these it bores through the knots, devours the internal tissues of the stem, and gradually makes its way down to the bottom of the stalk; this it proceeds to cut through almost level with the ground, but a little distance above the chosen resting place on the crown of the root, where it spins a fine web, and soon puts on the pupa state, in which it remains until the spring ensuing. The perfect insect is seen first in the beginning of May.

Prevention. It is obvious that as the pupa passes the winter in the lower part of the stems of the wheat-plant, the stems or stubble should be got off from corn-land when the injury has been sustained on account of this insect. This may be done by well working the ground with scarifiers, or cultivators, with sharp, broad tines or plates, so as to cut up all the stubble. This should be burnt at once. To plough the ground deeply immediately after the harvest would be effectual, if care were taken to bury all the stubble.

Remedies. Again, as in the case of other insects productive of similar harm to corn-crops, there is no practical remedy which farmers can adopt. There is a natural enemy in the form of parasite ichneumon fly, known as *Pachymerus calcitrator.* This is about the same size as the *Cephus,* dark-coloured, with a long exserted ovipositor as in most of these species of insects. With this it places its eggs in the bodies of the larvæ of the *Cephus,* from which eggs larvæ are soon developed. These quickly eat up the victimised entertainers of strangers unawares ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CER'ASIN. *Syn.* PRUN'INE. The insoluble portion of cherry-tree gum. It is identical with bassorin. Dr John applies the term to all those gums which, like tragacanth, swell, but do not dissolve in water. See BASSORIN.

CE'RATE. *Syn.* CERATUM, L. A thick species of ointment containing wax. Cerates are intermediate in consistence between ointments and plasters; but are less frequently employed than either of those preparations. The medicinal ingredients which enter into the cerates are very numerous; indeed, almost every kind of medicine capable of exercising a topical effect may be prescribed in this form.

It is a general custom with the druggists to use a less quantity of wax for their cerates than that which is necessary to give them a proper consistence, and in many cases it is omitted altogether, and its place supplied by hard suet or stearine, and frequently by common resin. Lard is also very generally substituted for olive oil. The operation of melting the ingredients should be performed in a water-bath or steam-bath, and the liquid mass should be assiduously stirred until cold.

All the medicated cerates may be prepared by adding the active ingredients, in the form of fine powder, soft extract, solution, &c., as the case may be, to either simple cerate or spermaceti cerate, in the proportions indicated under the head of 'Doses' appended to every article of importance noticed in this work. The mixture, which must be complete, may be effected by working the articles together on a marble or glass slab or tile, or, still better, by trituration in a clean wedgewood mortar. In some cases the simple cerate is melted by a gentle heat, and the whole stirred or triturated until nearly solid; in others, digestion with heat is employed. When aqueous extracts are ordered in cerates, the extract must be thinned with a little water before mixing.

Cerate. *Syn.* SIM'PLE CERATE, SIMPLE DRESS'-ING; CERA'TUM (Ph. L.), C. SIM'PLEX (Ph. L. 1824). *Prep.* (Ph. L.) Yellow wax, 20 oz.; melt by a gentle heat; add olive oil, 1 pint; and stir until it begins to solidify.

Used as a simple emollient dressing. The corresponding preparations of the other colleges will be found noticed under OINTMENTS. The *Ceratum simplex* of the Ph. E. is SPERMACETI CERATE.

Cerate, Ac'etate of Lead. *Syn.* CE'RATE OF SUGAR OF LEAD; CERA'TUM PLUM'BI ACETA'TIS (Ph. L.), L. *Prep.* (Ph. L.) White wax, 5 oz.; olive oil, 18 fl. oz.; melt together; add acetate of lead (in fine powder), 5 dr., previously triturated with olive oil, 2 fl. oz., and stir till they unite (begin to solidify). Used as a cooling dressing to burns, excoriations, and inflamed sores.

Cerate, Ammoni'acal. *Syn.* CERA'TUM AMMONIA'CALE. L. *Prep.* (*Rechoux.*) Simple cerate, 1 oz.; carbonate of ammonium, 1 dr.; mix. As a counter-irritant in croup, &c.

Cerate, Arsen'ical. *Syn.* CER'ATUM ARSEN'ICI, C. A'CIDI ARSENIO'SI, L. *Prep.* 1. (Ph. U. S.) Arsenious acid (in very fine powder), 20 gr.; simple cerate, 1 oz.

2. (*Sir A. Cooper.*) Arsenious acid and sublimed sulphur, of each, 1 dr.; spermaceti cerate, 1 oz. The above ingredients must be very carefully triturated together. The first is used as a dressing to cancerous sores; the second is applied on lint as a caustic in like cases.

Cerate, Belladon'na. *Syn.* CERATE OF DEADLY NIGHTSHADE; CERA'TUM BELLADONN'Æ, L. *Prep.* 1. (*W. Cooley.*) Extract of belladonna, 3 dr.; simple cerate, 1 oz.; olive oil, 1 dr.; triturate to-

gether in a warm mortar until nearly cold. Used in frictions to indolent tumours.

2. (Compound); C. B. COMPOS'ITUM, L. *Prep.* (*W. Cooley.*) Belladonna cerate, 1 oz.; iodide of gold, 12 gr.; carefully triturated together. Used as a friction to scrofulous and syphilitic tumours, and to remove syphilitic and rheumatic pains. A most active and excellent preparation.

Cerate, Brown. See PLASTERS.

Cerate, Caca'o. *Syn.* CACA'O POMMADE. *Prep.* Butter of cacao, white wax, and oil of almonds, equal parts, melted together and strained. Used as a cosmetic for chapped hands and lips, &c.

Cerate, Cala'mine. *Syn.* TURNER'S CERATE, HEALING SALVE; CERATUM CALAMI'NÆ (Ph. L. & E.), C. LA'PIS CALAMINA'RIS (Ph. L. 1788), L. *Prep.* 1. (Ph. L.) Yellow wax, 7½ oz.; olive oil, 1 pint; melt together, remove the vessel from the fire, and when they first begin to thicken, add prepared calamine, 7½ oz., and stir constantly until they cool.

2. (Ph. E.) Prepared calamine, 1 part; simple cerate (Ph. E.), 5 parts; mix.

3. (Ph. D.) See OINTMENT.

4. (Commercial.) Hard suet, 5 lbs.; lard, 3 lbs.; melt and sift in, gradually, calamine, 4 lbs.; agitate well for a few minutes, or until the whole is perfectly mixed, and after one minute's repose pour it off into another vessel, the coarse sediment that has fallen to the bottom being carefully avoided; lastly, stir assiduously until it is nearly cold. This forms the TURNER'S CERATE of the wholesale druggists. In many cases nothing but lard and calamine are used.

Uses, &c. When honestly prepared with genuine calamine, it is a most valuable desiccant and astringent application to excoriations, ulcers, burns, scalds, sore nipples, &c. It has long been held in popular esteem as a drying and healing dressing for sores.

Cerate, Cal'amine with Mercury. *Syn.* CERA'TUM CALAMI'NÆ CUM HYDRAR''GYRO, L. *Prep.* (Ph. Chirur.) Calamine cerate, 1 lb.; red oxide of mercury, 1 oz.; mix. Used as a stimulant application to foul and indolent ulcers, psorophthalmia, &c.

Cerate, Cal'omel. *Syn.* CERA'TUM CALOMELA'NOS, C. HYDRAR''GYRI CHLORIDI, L. *Prep.* 1. Calomel, 1 dr.; spermaceti cerate, 7 dr. In herpes and some other skin diseases.

2. (Compound; C. C. COMPOSI'TUM, L.) Calomel, 2 dr.; calamine cerate, 1 oz.; olive oil, 1 dr.

Cerate, Cam'phor. *Syn.* CERA'TUM CAMPHORA'TUM, C. CAMPHOR'Æ, L.; POMMADE DU FRÈRE COSME, Fr. *Prep.* Olive oil, 1 lb.; white wax, ½ lb.; camphor, 3 dr. As an application to chaps, chilblains, abrasions, excoriations, and slight wounds. See BALLS, CAMPHOR.

Ceratum Camphoræ Compositum (Compound Camphor Cerate); CERATUM CAMPHORATUM (Camphor Ice). Camphor (in coarse powder), 1½ oz.; white wax, 2 oz.; castor oil, 4 oz.; spermaceti, 7 oz.; carbolic acid (liquefied by warming), 10 min.; oil of bitter almond, 6 min.; benzoic acid, 60 gr.

Cerate, Canthar'ides. *Syn.* BLISTERING CERATE; CERA'TUM LYTT'Æ, C. CANTHAR'IDIS, L. *Prep.* 1. (Ph. L.) Cantharides (in very fine powder), 1 oz.; spermaceti cerate, 6 oz.; mix.

2. (*Parrish.*) Cantharides, 12 parts; lard, 10 parts; yellow wax and resin, of each, 7 parts; incorporated by fusion. Irritant; used to keep blisters open and to stimulate issues, and indolent ulcers and tumours.

Cerate, Chalk. *Syn.* CERA'TUM CRE'TÆ, L. *Prep.* 1. Chalk (thoroughly dried, and in fine powder), 2 dr.; simple cerate, 6 dr.; almond oil, 3 dr. Used in piles and foul ulcers.

2. (Acetated.) See CERATE, KIRKLAND'S NEUTRAL.

3. (Compound; CERA'TUM CRE'TÆ COMPOSI'TUM, L.) *a.* To simple chalk cerate, 1 oz., add powdered catechu, ½ dr. In piles and foul and indolent ulcers.

b. (U. S. Hospital.) Lead plaster and olive oil, of each, 8 oz.; white wax, 3 oz.; melt together; add solution of subacetate of lead, 6 oz.; thoroughly incorporate, and then further add chalk (in fine powder), 5 oz. Cooling and astringent. Useful in inflamed sores, excoriations, piles, &c.

Cerate, Cher'ry-laur'el. *Syn.* CERA'TUM LAURO-CERASI, C. CALMANS, L. *Prep.* (*Roux.*) Simple cerate, 1 oz.; cherry-laurel water, ½ oz. As an application to burns.

Cerate, Cin'nabar. *Syn.* CERA'TUM RU'BRUM, C. CINNABA'RIS, C. HYDRAR''GYRI SULPHURE'TI RU'BRI, L. *Prep.* 1. Camphor, 20 gr.; vermilion, 60 gr.; simple cerate, 1 oz. This is Alibert's 'ANTIHERPETIC POMADE.'

2. (Ph. Chirur.) Yellow wax and lard, of each, ½ lb.; yellow resin, ½ oz.; red sulphide of mercury, 1 dr. Used as a common dressing.

Cerate, Cit'rine. See CERATE, RESIN, NITRATE OF MERCURY C.

Cerate, Cop'per. *Syn.* CUPRIA'TED CERATE; CERA'TUM CU'PRI; C. C. AMMONIA'TI, L. *Prep.* (*Swediaur.*) Simple cerate, 8 parts; melt, and add solution of ammoniuret of copper, 1 part. As a stimulant dressing for indolent ulcers; and in psorophthalmia, &c.

Cerate, Cosmet'ic. *Syn.* COLD CREAM, CERATE OF GA'LEN; CERA'TUM COSMET'ICUM, C. GALENI, CREMOR FRIGIDA, L.; POMMADE EN CRÊME, Fr. *Prep.* 1. Oil of sweet almonds, 1 lb.; white wax and spermaceti, of each, 2 oz.; melt, pour the mixture into a marble or wedgwood mortar, which has been heated by standing for some time in boiling water; add, gradually, rose water, 10 fl. oz., assiduously stirring until an emulsion is formed; then further add, oil of bergamot, ½ oz.; oil of lavender, 1 dr.; and continue the stirring or trituration until the whole has become cold.

2. To the last add otto of roses, 1 dr.; oil of rosemary, 15 drops.

3. Oil of almonds, 5 oz.; spermaceti, 5 dr.; white wax, 4 dr.; rose water, 3½ oz.; balm of Mecca (genuine), 8 drops.

4. As the last, with essence of vanilla, 15 drops; essence of ambergris, 10 drops.

5. (P. C.) White wax, 1 part; oil of almonds, 4 parts; rose water, 3 parts; as before.

6. (*Van Mons.*) White wax and butter of cacao, of each, 1 part; oil of almonds and rose water, of each, 4 parts.

Obs. The above are used as agreeable and cooling emollients for irritable surfaces, excoriations, sore nipples, &c. See COLD CREAM and OINTMENTS.

Cerate, Cro'ton. *Syn.* CERA'TUM CROTO'NIS, L. *Prep.* (*Caventou*.) Lard, 5 parts; wax, 1 part; melt, and when nearly cold add croton oil, 2 parts. Used as a counter-irritant; but is apt to affect the bowels.

Cerate, Goulard's. See CERATE, LEAD.

Cerate, Hem'lock. *Syn.* CERA'TUM CO'NII, L. *Prep.* (St B. Hosp.) Spermaceti, 2 oz.; white wax, 3 oz.; melt, and of hemlock ointment, 12 oz. Used for inveterate cancerous, scrofulous, and other sores.

Cerate, Hon'ey. *Syn.* CERA'TUM MEL'LIS, L. *Prep.* 1. Simple cerate, 3 parts; honey, 1 part; oil of lemon grass, 6 drops. Used as cold cream.

2. (Ph. Chirur.) Olive oil, ½ lb.; wax and lead plaster (or galbanum plaster), of each, 4 oz.; melt, and add honey, ½ lb. As a cooling emollient dressing.

Cerate, Kirk'land's. *Syn.* KIRKLAND'S NEUTRAL CERATE; CERA'TUM NEUTRA'LE, C. CRE'TÆ ACETA'TIS, L. *Prep.* 1. Lead plaster, 8 oz.; olive oil, 4 oz.; melt, sift in chalk, 4 oz.; mix well, then add gradually Goulard's extract, ½ oz.; distilled vinegar, 4 oz.; and stir until cold.

2. (Paris.) Lead plaster, 8 oz.; olive oil and chalk, of each, 4 oz.; sugar of lead, 3 dr., (dissolved in) distilled vinegar, 4 fl. oz. As a cooling dressing to irritable ulcers and excoriated parts.

Cerate, Lead (Compound). *Syn.* GOU'LARD'S CERATE; CERA'TUM PLUM'BI COMPOS'ITUM (Ph. L.), L. *Prep.* (Ph. L.) Olive oil, 16 fl. oz.; yellow wax, 8 oz.; melt, remove the vessel from the fire, and when they begin to thicken, add gradually solution of subacetate of lead (slightly warmed), 6 fl. oz.; and stir constantly until the whole is nearly cold; then add camphor, 1 dr., dissolved in olive oil, 4 fl. oz. (by heat), and stir until the cerate is quite cold. Used in similar cases to KIRKLAND'S CERATE (which *see*). See also ACETATE OF LEAD CERATE.

Cerate, Mar'shall's. *Prep.* 1. Palm oil and calomel, of each, 2 oz.; acetate of lead, 1 oz.; ointment of nitrate of mercury, 4 oz.; triturated together in a wedgewood mortar.

2. (Paris.) Palm oil, 5 oz.; calomel, 1 oz.; acetate of lead, ½ oz.; citrine ointment, 2 oz.; as the last. Applied to the eyes, &c.

Cerate, Mercu''rial. *Syn.* CERA'TUM MERCURIA'LE, C. HYDRAR''GYRI, L. *Prep.* 1. (*Guibourt.*) Strong mercurial ointment and simple cerate, equal parts.

2. (Ph. L. 1746.) Strong mercurial ointment and yellow wax, of each, 6 oz.; lard, 3 oz. Both are used as dressings to venereal ulcers.

3. (Compound; CERA'TUM MERCURIA'LE COMPOS'ITUM, C. HYDRAR''GYRI, L.) *Prep.* (Ph. L.) Mercurial ointment (strong) and soap cerate, of each, 6 oz.; camphor (in powder), 1½ oz.; triturate together. Alterative and discutient; used to disperse indolent tumours and swellings, and as a resolvent in enlarged joints, &c.

Cerate, Mez'ereon. *Syn.* CERA'TUM MEZ'EREI, L. *Prep.* 1. Extract of mezereon, 1 part; (dissolved in) alcohol, 5 parts; add beeswax, 5 parts; olive oil, 11 parts; melt together, and continue the heat until all the alcohol is evaporated.

2. Green oil of mezereon, 1 part; simple cerate, 20 parts; melt together. Both are used to keep up the discharge from blistered surfaces, and as a stimulant application to indolent sores.

Cerate, Neu'tral. See CERATE, KIRKLAND'S.

Cerate, Ni'trate of Mer'cury. *Syn.* CIT'RINE CERATE; CERA'TUM HYDRAR''GYRI NITRATIS, L. *Prep.* (St B. Hosp.) Citrine ointment and simple cerate, equal parts. See OINTMENTS.

Cerate, O'pium. *Syn.* LAUD'ANUM CERATE, AN'ODYNE C.; CERA'TUM O''PII, C. OPIA'TUM, C. ANODY'NUM, L. *Prep.* 1. Tincture of opium and olive oil, of each, 2 dr.; simple cerate, 1 oz.; digest with heat until all the spirit and water is evaporated, constantly stirring the mixture all the time.

2. (*Gilbert.*) Wine of opium 1 dr.; simple cerate, 1 oz.

3. (*Lagneau.*) Opium (in fine powder), ½ dr.; yelk of 1 egg; mix, then triturate it with simple cerate, 1 oz.

Uses. The above are applied to painful swellings, piles, and ulcers, and in chronic ophthalmia, &c.

Cerate, Phosphora'ted. *Syn.* CERA'TUM PHOSPHO'RI, C. PHOSPHORA'TUM, L. *Prep.* 1. Phosphorus, 6 gr.; simple cerate, 3 oz.; heat together in a phial placed in a water-bath, with frequent agitation for 2 hours; and after repose for 10 minutes, pour off the clear portion, and stir it well until cold.

2. (*Foy.*) Phosphorated ether, 5 parts; simple cerate, 24 parts.—*Uses.* Both of the above have been recommended as frictions in obstinate cutaneous affections, and in rheumatism of the joints.

Cerate, Pitch. *Syn.* CERATUM PI'CIS BERGUNDI'CÆ, L. *Prep.* (*Beral.*) White wax, 3 parts; suet, 4 parts; Burgundy pitch, 6 parts; melted together. A mild stimulant and detergent dressing. See OINTMENTS.

Cerate, Resin. *Syn.* BASIL'ICON, B. CERATE, B. OINTMENT, YELLOW B., CIT'RINE CERATE; CERA'TUM CITRI'NUM (Ph. L. 1788), C. RESI'NÆ, FLA'VÆ (Ph. L. 1745), C. RESI'NÆ (Ph. L. 1809 and since), L. *Prep.* 1. (Ph. L.) Yellow resin and beeswax, of each, 15 oz,; melt, add olive oil, 1 pint; strain through a cloth, and stir the mixture until cold.

Obs. The above is the formula of the London College, but the basilicon of the shops is seldom, if ever, made in this manner. The following forms are those commonly used in trade, but the products are much inferior to that made according to the directions in the Pharmacopœia:

2. (Commercial.) *a.* Yellow resin, 10 lbs.; beeswax, 2 lbs.; linseed oil, 7 lbs.; melt together, and stir until cold.

b. As the last, but using nut oil instead of linseed oil.

c. Nut oil, 1 gall.; beeswax, 5 lbs.; yellow resin, 14 lbs.

d. Lard (common) and linseed oil, of each, 3 lbs.; yellow resin, 9 lbs.; as before.

Uses, &c. This cerate is a mild stimulant, detergent, and digestive application; and as such is employed to dress foul and indolent ulcers, blistered surfaces, burns, &c. For the corresponding preparations of the other colleges, see OINTMENTS.

3. (Compound; DESH'LER'S CERATE; CE-

RA'TUM RESI'NÆ COMPOS'ITUM, L.) *Prep.* (Ph. U. S.) Resin, suet, and beeswax, of each, 1 lb.; turpentine, ½ lb.; flax-seed oil (linseed oil), ½ pint; as above. Rather more stimulating than resin cerate, but used for the same purposes.

Cerate, Rose. *Syn.* LIP SALVE; CERA'TUM ROSA'TUM, L. *Prep.* (P. C.) Oil of almonds, 16 parts; white wax, 8 parts; alkanet root, 1 part; digest, with a gentle heat, until sufficiently coloured, then strain, and for every ounce of the cerate, add otto of roses, 2 drops. See LIP SALVE.

Cerate, Sav'ine. *Syn.* CERA'TUM SABI'NÆ (Ph. E.; and Ph. L. 1836), L. *Prep.* 1. (Ph. E.) Beeswax, 1 part; lard, 4 parts; fresh savin (leaves bruised), 2 parts; boil together until the leaves become crisp, then strain with pressure, through a linen cloth.

2. (Ph. L. 1836.) Lard, 2 lbs.; savin leaves, 1 lb.; beeswax, ½ lb.; as last.

3. (Ph. L. 1851.) In the B. P. this preparation is included among the OINTMENTS (which *see*); in trade, however, the old name (Ph. L. 1836) is still generally retained.

The following forms are those commonly adopted by the wholesale druggists for the manufacture of this cerate:

4. Lard and suet, of each, 6 lbs.; yellow wax, 2 lbs.; melt them together in an earthen vessel; add 2 oz. of distilled verdigris (previously rubbed down smooth in a mortar with an equal weight of sweet oil); strain, whilst hot, into a large earthen pot, and when the whole has cooled a little, add of oil of savin, 1 oz., and stir until cold.

5. Savin leaves, 4 lbs.; yellow wax, 2 lbs.; lard, 8 lbs; boil until the leaves become crisp; then strain, and add, of green ointment (lively coloured), 5 lbs.; when cooled a little, further add, of oil of savin, 3 dr., and stir briskly until cold. *Prod.*, 13½ lbs.

Uses, &c. Savin cerate and ointment are chiefly employed to keep up the discharge from blisters (perpetual blisters), for which purpose it is preferable to preparations of cantharides. The practice of colouring this cerate with verdigris, which is general in trade, cannot be two severely censured, as its therapeutic action is thereby altered. The copper may be detected by burning down a little in a platinum or porcelain crucible, washing out the ashes with a little dilute nitric acid, placing the liquor in a glass tube, and applying the usual tests. See COPPER and OINTMENTS.

Cerate, Sim'ple. *Syn.* CERA'TUM SIM'PLEX, L. *Prep.* 1. (Ph. E.) Spermaceti, 1 part; white wax 3 parts; olive oil, 6 parts; melt by a gentle heat, and stir until cold. This preparation is similar to SIMPLE OINTMENT (*Unguentum simplex*), B. P. (which *see*).

Cerate of Snails. White wax, 3 parts; spermaceti, 3 parts; oil of almonds, 32 parts; mucilage of snails, 24 parts; otto of rose, sufficient to scent it.

Cerate, Soap. *Syn.* COMPOUND SOAP CERATE; CERA'TUM SAPO'NIS (Ph. L. 1836), C. SAPONIS COMPOS'ITUM (Ph. L. 1851), L. *Prep.* 1. (Ph. L.) Boil litharge, 15 oz. in distilled vinegar, 1 gall. until dissolved, stirring continually; then add Castile soap, 10 oz.; again boil until all the moisture is evaporated; then add, gradually, beeswax, 12½ oz., and olive oil, 1 pint, previously melted together, and stir until nearly cold. Similar to SOAP CERATE PLASTER (*Emplastrum Cerati Saponis*), B. P. (which *see*).

2. (Wholesale.) Distilled vinegar, 6 galls.; litharge, 5 lbs.; soap, 3¾ lbs.; yellow wax, 4½ lbs.; olive oil, 6 pints. Mix as above. Good nut or poppy oil may be used instead of olive oil.

Obs. Unless the instructions contained in the above formulæ are followed in every particular, the process is apt to miscarry. When this is the case, the cerate, on cooling, separates into two portions, and is commonly full of hard, gritty particles. To prevent this, care should be taken to use soap of the best quality. This mishap cannot be got over by long boiling and stirring, as is generally supposed. The only remedy is the addition of a little more soap, previously melted with some water, and again evaporating to a proper consistence. A small quantity of solution of potassa has a similar effect.

The colour and consistence of soap cerate chiefly depend on the length of time it is kept heated after the addition of the oil and wax. As evaporation proceeds, so the colour and consistence increase. Its colour is that of a lively, pale chocolate-brown, but occasionally it is much paler. This arises from its containing an undue quantity of moisture. When it has been kept heated for a period beyond that usually adopted, it attains greater hardness, and is then frequently called hard soap cerate (CERATUM SAPONIS DURUM); but by over-boiling it is apt to become gritty.

Uses, &c. Soap cerate is resolvent, cooling, and desiccative, and is chiefly employed as a cooling dressing for scrofulous swellings, &c. It may be spread on linen and applied like a plaster. It is sometimes used as a support for fractured limbs, and forms an excellent dressing for soft corns.

Cerate, Spermace'ti. *Syn.* WHITE CERATE, WHITE LIP SALVE, SIMPLE C.; CERATUM SIM'PLEX (Ph. E.), C. ALBUM (Ph. L. 1745), C. SPERMA'TIS CE'TI (Ph. L. 1788), C. CETA'CEI (Ph. L. 1809 and since), L. *Prep.* 1. (Ph. L.) Spermaceti, 2 oz.; white wax, 8 oz.; melt by a gentle heat; add, olive oil (warm), 1 pint, and stir with a spatula until they cool.

2. (Ph. E.) See CERATE, SIMPLE.

3. (Ph. D.) The corresponding preparation of the Ph. D. is classed under OINTMENTS, and contains lard.

4. (Commercial.) On the large scale lard or suet is substituted for oil, by which means less wax is required. The following is a good form where a cheap article is wanted, and is that commonly adopted in the wholesale trade:

Clarified mutton suet, 5½ lbs.; white wax and spermaceti, of each, ¾ lb.; as above.

Obs. The materials should be melted by a very gentle heat (that of a water-bath is best) in a clean stoneware vessel, and as soon as perfect liquefaction takes place, the heat should be withdrawn, and the fluid cerate strained into a clean vessel, and stirred with a clean wooden spatula until it solidifies. To facilitate the cooling, the vessel may be placed in cold water or in a current of cold air. In this way the product is rendered

both whiter and finer than when the liquid mass is allowed to cool by itself. By adding a little flowers of benzoin with the oil, or a little nitric ether when the cerate is about half cold, this, as well as other like preparations, will keep for years without becoming rancid or suffering any material change of condition.

Uses, &c. Emollient and cooling. It is commonly employed as a soft, cooling dressing, as a lip salve, as an application to chaps, chilblains, &c.

Cerate, Sul'phide of Mer'cury. *Prep.* (*Swediaur.*) Yellow resin, ½ oz.; yellow wax and lard, of each, ½ lb.; vermilion, 20 gr. As a dressing to unhealthy ulcers. See CERATE, CINNABAR.

Cerate, Sul'phur. *Syn.* CERA'TUM SULPHU'RIS, C. SULPHURA'TUM, L. *Prep.* (P. C.) Washed sulphur, 2 parts; cerate of Galen, 7 parts; almond oil, 1 part; mix. In itch, &c.

Cerate, Tobac'co. *Prep.* Beeswax, 3 oz.; yellow resin, 1 oz.; olive oil, 6 oz.; tobacco juice, 4 oz.; mix and evaporate to dryness, and when nearly cold, add bergamot, 2 dr. Used to destroy pediculi, &c.

Cerate, Turner's. See CERATE, CALAMINE.

Cerate, Ver'digris. *Syn.* CERA'TUM ÆRU'GINIS, C. CU'PRI DIACETA'TIS, L. *Prep.* 1. Resin cerate, 19 parts; verdigris (in fine powder), 1 part.

2. (For. Ph.) Wax and resin, of each, 6 parts; Venice turpentine, 5 parts; linseed oil, 2 parts; verdigris, 1 part. Used as a mild escharotic and stimulant to fungous ulcers, warts, corns, &c.

Cerate, White. See CERATE, SPERMACETI.

Cerate, Zinc. *Syn.* CERA'TUM ZINC'I, C. Z. OXY'DI, L. *Prep.* 1. Oxide of zinc, 20 gr., spermaceti cerate, 1 oz. Used in sore nipples, excoriations, &c.; and in chronic ophthalmia.

2. (Compound; CERA'TUM ZINCI COMPOSITUM, L.) *a.* To the last add calomel, 10 gr. Used as the last, and in scrofulous ophthalmia.

b. (Mid. Hosp.) Zinc ointment and compound lead ointment, equal parts. Cooling, astringent; in excoriations, and as a dressing for ulcers.

c. (*Hufeland.*) Oxide of zinc and lycopodium, of each, 15 gr.; simple cerate, ½ oz. In sore nipples, ulcerations of the breast, tetters, &c. It acts best when diluted with half its weight of spermaceti cerate.

d. (U. S. Ph., 1870.) Precipitated carbonate zinc, 2 oz.; simple cerate, 10 oz. A substitute for calamine cerate.

CEREB'RIC ACID. A peculiar acid compound, first noticed by M. Frémy, obtained along with oleo-phosphoric acid when the brain and nerves are treated with hot alcohol. It is solid, white, crystalline; freely soluble in boiling alcohol, and forms a solid gelatinous mass with hot water; fusible with decomposition, exhaling a peculiar odour, and leaving much charcoal behind. It has been found also in the yelk of eggs, in seminal fluid, and in pus. With the alkalies it forms insoluble salts termed cerebrates.

CEREB'ROLEIN. When oleo-phosphoric acid is boiled in water, it is resolved into a fluid neutral oil and phosphoric acid, which dissolves. The former is cerebrolein.

CERIN. *Syn.* ALLANITE; ORTHITE; BUCKLANDITE. A mineral found in Greenland, Norway, and the Ural. It is composed of silicate of alumina, iron, cerium, and lime, and occurs in rhomboclinic prisms, or black masses with a glassy lustre ('Dict. de Chim.,' Wurtz).

Cerin. This name was given by John to the part of beeswax which is soluble in alcohol, and, according to Brodie, consists of impure cerotic acid ('Dict. de Chim.,' Wurtz).

Cerin. A substance that may be extracted by chloroform from cork, in which it occurs to the extent of 2% (Watts's 'Dict. of Chem.'). This name was given to it by Chevreul.

CERIUM. Ce. Atomic weight 139·9. A metal first obtained by Mosander in 1826. Specific gravity 6·53—6·73. Melting-point above that of antimony, but below that of silver.

Occurrence. In cerite (a silicate of cerium) and other minerals found in Sweden. It has recently been discovered to exist in large quantities in clay used for brickmaking at Hanistadt, near Frankfurt.

Prep. The metal has been prepared by Wöhler, by adding sodium to a molten mixture of cerium, potassium, and ammonium chlorides. Hillebrand and Norton have electrolysed the chloride Ce_2Cl_6 and obtained nearly pure cerium. The starting-point for cerium compounds is the silicate, cerite, which is converted successively into the sulphate, the oxalate, and the oxide. They have to be separated from salts of lanthanum and didymium, by a tedious process of fractional precipitation.

Prop. It is a ductile and malleable metal of a steel-grey colour. It burns brightly in air, and also in vapours of chlorine, bromine, iodine, sulphur, and phosphorus. It slowly decomposes cold water, but hot quickly.

Chief Compounds. Oxides, Ce_2O_3 and CeO_2. The chloride, $CeCl_3$. A fluoride, CeF. The oxalate may be obtained as a precipitate by adding a solution or ammonium oxalate to a solution of cerium salt. (Ph. B.)—*Dose*, 1 to 2 gr. Given in vomiting during pregnancy. (See Watts's 'Dict. of Chem.' for further particulars on this subject.)

CEROSTOMA XYLOSTELLA, Curtis. The Turnip Diamond-back Moth. From κέρας, a horn, as this insect stretches forward its antennæ or horns in a peculiar manner when at rest. It is called *xylostella* from *Xylosteum*, a section of the honeysuckle genus, as it is found on honeysuckles.

It could hardly be considered possible that such a tiny moth was able to cause serious injuries to crops, and especially to root crops. In some seasons, however, turnips and other plants of the *Brassicæ* are materially damaged by its caterpillars, which congregate together upon the leaves, covering them with their excessively fine webs, and devour every particle of the foliage. During the past 10 years it appears to have been troublesome in various parts of the kingdom, though Curtis speaks of it as as being abundant in turnip-fields, and causing considerable mischief to swedes and turnips 50 years ago ('Farm Insects,' by John Curtis).

Stephens says it is abundant in gardens and weeds during the greater part of the summer within the metropolitan district, also in Devon-

shire, the New Forest, near Dover, and in Scotland ('Illustrations of British Entomology, Haustellata,' by J. F. Stephens). Stainton shows, in his 'Manual of British Moths and Butterflies,' that it is found in most parts of England. It is also well known and has occasioned much injury in various places in Ireland. It is doubtful, however, whether it is not more common than has been supposed, and that the attacks may have been attributed to the turnip saw-fly, whose caterpillars are called 'niggers' ('Report of Observations of Injurious Insects, 1883,' by E. A. Ormerod).

It seems very probable that the caterpillars of other flies, moths, and butterflies, have been mistaken for those of the diamond-back moths. Or it may be that its attacks have become intensified in these later years in the same degree as those of other insects.

There was a great invasion of this enemy in certain districts of Kent, Sussex, and Essex, among other places, in 1883. It injured turnips, swedes, kohl rabi, and thousand-headed kale. A correspondent stated that he had a plot of swedes so badly affected that he had to plough it up. Another wrote that the leaves of the swedes were covered with patches of a web-like material, which looked very peculiar in the morning before the dew was off. The caterpillars within this were fast devouring the plants. It was remarked that the injury commenced in a corner bounded by a wide hedgerow, and spread gradually over the field. It should be noted that in very many cases of reported injury from this moth, the attacked crops were in fields skirted by hedge-rows and copses.

Again, in 1884 and 1885, reports of injury were sent in from many farms in several counties, both in the north and south of England, also in Scotland and Ireland.

The diamond-back moth is known on the Continent. Kaltenbach and Taschenberg speak of it; the latter under the synonym of *Plutella cruciferarum.*

Life History. The diamond-back moth is placed in the large group *Tineina,* of the Nat. Ord. LEPIDOPTERA, a group or genus of moths both numerous and destructive to plants, grain, furs, clothes, skins, and other substances. Stainton arranges the genus *Cerostomata,* to which this moth belongs, in the family *Clutellidæ.*

Like many of the *Tineina* it is a very pretty insect, and varies in colour, or rather in shades of colour, in different specimens. Thus some are reddish brown, while others are pale brown. The typical insect is reddish brown, with very long white antennæ, or horns, having a white streak right across the anterior or fore-wings, which are brown. The white streak upon the wings when they are folded forms patches resembling diamonds in shape, from which the moth takes its name, diamond-back. Its posterior or hind wings are lighter than the fore wings, with long delicate fringes. In length of body it is from 5 lines to ½ inch, with a wing expanse of from ¾ inch to 10 lines.

Appearing first in the early part of May, the female moth lays quantities of eggs fastened together in a mass upon certain plants with glutinous material. They are generally placed upon cruciferous plants, and those wild, hedge-row, or weed-plants, at least by the first generation of moths, such as charlock or cadlock (*Sinapis arvensis*), penny-cress (*Thlaspi arvense*), hedge mustard (*Sisymbrium officinale*), flixweed (*Sisymbrium sophia*). Later on the eggs are placed upon cultivated cruciferous plants.

From the eggs come caterpillars in a few days and feed upon the leafage near to them.

The caterpillar is close upon ½ inch in length, of a light green colour with a yellowish tinge here and there, and an ash-grey head. It has 16 green feet, and its body tapers somewhat towards the head and tail. After feeding for some time it changes to an ash-coloured, or grey chrysalis, with dark spots upon it, from which in about 12 days the moth comes forth, and has then a wide choice of cultivated plants upon which it may place its eggs.

From observation as to the habits of this moth, it is gathered that the first generation of caterpillars, or at all events those whom fate has fixed upon wild plants, do not remain in this state nearly so long as those upon cultivated plants, as swedes for example. Their food derived from weeds is not appetising, and, which is more to the point, does not last long, as the leaves get tough very quickly and devoid of juices. The second generation on the more congenial cultivated plants are far more numerous (Curtis says, in 'Farm Insects,' that as many as 240 caterpillars have been seen on one turnip plant), far more dangerous, and remain longer in caterpillar form. I have not specially noticed other species of the LEPIDOPTERA in this respect, but I have no doubt that the same holds with regard to most of these injurious to crops. The diamond-back moth passes the winter in the chrysalis state, under dead leaves and rubbish upon the ground.

Prevention. After an attack upon swedes, turnips, and other cultivated plants, there is not much danger for another season if the land is properly ploughed in the ordinary course of cultivation. The chrysalids being on the surface would be ploughed in and be destroyed. Fallow land, upon which charlock may be which has lived through the winter, should be ploughed early in the spring. In seeds, that is, rye-grass and clovers of various kinds sown with wheat, barley, or oats, and in sainfoin leys, there are often many plants of charlock, self-sown rape, and other cruciferous plants which live through the winter, and form attractive objects for the moth to lay eggs upon in the spring. It would pay well to brush them off close to the ground in the spring.

If any other reason were wanted for the extirpation of this abominable weed, charlock, it might be urged that it is a breeding-place for the diamond-back moth.

Early spring brushing of hedge-sides and hedge-rows, ditches, and other places harbouring weeds, is strongly advocated.

Remedies. In passing a field of swedes near Dorking, a peculiar horse-hoe was remarked, from whose sides arms, or wings, projected. Upon examination it was found that the ingenious farmer had fastened bunches of birch on either side of the implement, arranged so as to lightly

brush the plants as the hoe passed along, and to dislodge the caterpillars that were upon their leaves. These caterpillars were those of the saw-fly niggers; but the remedy is equally applicable in the case of the diamond-back caterpillars. Birch may be used for these brushes, or green brooms, or other boughs sufficiently elastic. Immediately after this horse-hoe with the brushes, another should follow, set wide so as to take all the ground and bury or kill the caterpillars, and prevent them from crawling back again.

In case of a very bad attack, washing with soft soap and quassia would certainly be efficacious if it could be done. It might be done by means of garden-engines, like those used for washing hop-plants, only set upon four high wheels, wide apart, so as to travel over a row of plants. The pump-handle should be on one side, and there should be two long flexible hose with proper sprays, just as in hop-washing, with which the rows on either side for some distance would be washed or syringed. It would be necessary that the washing machines should be set upon high wheels, and go across a field over a row of plants; otherwise they must be made very narrow, and consequently very elevated and difficult to work.

The Americans have most elaborate machines for 'sprinkling' plants infested with various insects, but none are so simple or so effectual as the common hop-washing machine.

One of these American 'sprinklers' is an oblong tin case carried on a man's back, having two hose attached, with which the liquid from the case is sprinkled on the plants. Another is a rather large case, to be carried by a man on horseback; and there are several elaborate arrangements of tanks upon wheels, with lengths of hose or lengths of iron tubing, perforated at intervals with holes for the distribution of the liquid.

Broadcasting soot and sulphur upon the plants attacked by the diamond-back caterpillars is a useful remedy if done when the dew is upon them (25 bushels of soot and 12 lbs. of sulphur per acre form a useful dressing). Lime also has been found efficacious.

Manures, such as sulphate of ammonia, guano, nitrate of soda, will force the plants along quickly out of the way of the caterpillars.

Natural Enemies. Rooks, jays, partridges, starlings, peewits, thrushes, are fond of these caterpillars, and should not be molested.

There is a parasite which keeps this insect in check. It is an ichneumon fly, known as *Campoplex paniscus*, black, with four brilliant wings, in length about the 1-5th of an inch, with a wing-expanse of little more than a $\frac{1}{4}$ of an inch. This places its eggs in the bodies of the caterpillars (Reports on 'Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CEROTIC ACID. A substance occurring in beeswax, from which it is extracted by alcohol, and in Chinese wax in combination as ceryl cerotate. It was called cerin (which *see*) by John.

CERYL ALCOHOL. Occurs in Chinese wax, in the sweat on the wool of sheep, and on poppy heads, in combination with cerotic acid as ceryl cerotate.

CESSPOOLS. It may be well to point out that the local authorities of any district in which a cesspool is situated are required by the Public Health Act—1. To see that it is so constructed and kept as to prevent its becoming either a nuisance or detrimental to health. 2. That an examination of any cesspool can be made by the sanitary inspector, or by any officer appointed by the local authority, after notice of entry has been served upon those who are the occupiers of the premises on which it is situated. 3. The local authority may itself undertake the cleansing of a cesspool, or it may enact bye-laws imposing this duty on the occupiers of the premises. 4. If the local authority, after having undertaken the cleansing of a cesspool, fail to do its duty, it becomes liable, after notice from an occupier, for the payment to the said occupier of a penalty not exceeding 5*s.* a day during default. 5. Any person in an urban district who allows the contents of a cesspool to overflow, or to soak therefrom, incurs a penalty of 40*s.* for each offence, and a further charge of 5*s.* a day for the continuance of the offence after notice. 6. Information of any nuisance under the said Act in the district of any local authority may be given to such local authority by any person aggrieved thereby, or by any two inhabitant householders of such district, or by any officer of such authority, or by the relieving officer, or by any constable or officer of the police force of such district.

It does not come within our province to enter into details as to the best method of building a cesspool. We may, however, state that, owing to the defective and leaky construction of a cesspool, it very frequently becomes a serious source of dangerous contamination to the wells in the neighbourhood, as well as a ready means of contagion, when it contains the excreta of fever-patients. The outbreak of typhoid fever at the West-end of London in 1874, the origin of which was traced to the milk supply, was owing to the vessels in which the milk was collected in the country having been washed out with water taken from a well near a cesspool, into which ran the contents of a privy belonging to a house, some of the inmates of which were labouring under typhoid fever.

For a cesspool not to be injurious to health it should be water-tight and ventilated by a shaft; it should never be allowed to overflow, and should be sunk at as great a distance from houses or dwellings as possible.

CETIN. $C_{32}H_{64}O_2$. Chevreul applied this name to pure spermaceti. *Prep.* Dissolve spermaceti in boiling alcohol, and collect the crystals that are deposited as the solution cools. Bright pearly crystals, melting at 120°, and subliming at 670° F. See SPERMACETI.

CETONIA AURATA, Curtis. The Green Chafer. The green chafer, or golden chafer, as it is sometimes termed, resembles the common cockchafer, *Melolontha vulgaris*, and the small chafer, *Anisoplia horticola*, in the manner in which it attacks plants and trees. In its perfect state it feeds, like these insects, upon the leaves and flowers, and in its larval state upon the roots of plants and trees, but it must not be confounded, as it frequently is, with the small chafer, being essentially distinct.

Fortunately the green chafers are not very

plentiful, as their larvæ are very large and cause injury by biting and eating roots; and, besides, they are very long-lived. It is most important, therefore, to keep them down by all means, and to prevent them from increasing as so many injurious insects have increased in late years.

Not only does this beetle in its perfect state devour leaves of various fruit trees, but it also attacks their blossoms and eats their leaves and bites away their pistils and stamens in its attempts to extract the nectar from their corollæ. It may be seen in the daytime upon the blossoms of apple and pear trees, and particularly upon those of strawberry plants, and it can be easily caught then as it is heavy in its movements, and, like many other beetles, simulates death when it is disturbed. Roses are often visited and spoiled by the green chafer, and Westwood states that it is very fond of the flowers of the privet.

The larva, or grub, of the chafer sometimes causes serious harm to strawberry plants by biting their roots and devouring the succulent parts of these. The thick main stems of strawberry plants are sometimes cut through by it. Reports have come to hand during the last two seasons of its attack upon raspberry plants, into whose roots it had made great inroads, causing the plants to flag. Their leaves drooped and had a withered look. The young fruits fell off, which was not at all wonderful, seeing that four or five large fat grubs were 'pegging away' at the roots. It has been found at the roots of young apple, pear, and damson trees, whose roots showed plain marks of having been damaged by the bites of this insect.

Taschenberg states that the *Cetonia aurata* is known in Germany, and remarks that it injures the blossoms of fruit trees. In France, called *la Cétoine dorée*, it spoils roses and the blossoms of strawberry plants, while its larvæ are said to live upon their roots and those of fruit trees. There is a closely allied species in America which is found upon the blossoms of strawberry plants, though Professor Lintner thinks that its larvæ do not hurt their roots.

Life History. The *Cetonia aurata* is a species of the *Cetoniidæ*, a family of the division *Lamellicornes* (so styled from Latin words meaning plate- or leaf-horned, because the antennæ of the species are plate- or fan-shaped) of the Nat. Ord. COLEOPTERA. It is about $\frac{3}{4}$ of an inch in length, of a brilliant green colour with a golden tinge, having short antennæ with three fans or extremities. There are three points or spines upon the first pair of its legs, probably serving to make holes for egg-laying. It may be first seen early in May, flying from flower to flower in fine weather with its strong wings. Towards the end of June the female lays its numerous eggs deep in the ground, having made a hole by dint of digging, or having found a convenient cleft in the soil.

Larvæ are hatched from the eggs in about twelve days, and soon begin to feed upon the roots of plants, trees, and grasses that are within their reach. The larvæ remain in this state for at least two years. It is believed that the term is three years. Curtis says two or three years. During this time they live upon the food they obtain by gnawing roots, and it may be readily imagined that in three years a single one of these creatures would materially interfere with the well-being of even a large well-rooted plant or tree. They are about $1\frac{1}{2}$ inch long when fully grown, with thick much-wrinkled bodies of a dull white hue, and with rusty-coloured heads, and 3 pairs of red or brown legs. To one carelessly noticing these larvæ they would appear to be those of the cockchafer (*Melolontha vulgaris*). Close inspection would, however, show that they differ in having a brown spot on either side of their bodies just below the first joint or segment, and that they are covered with hairs. The larvæ of the cockchafer are quite smooth, and have no spots upon them. They are also larger than those of the green chafer.

When the time of pupation arrives the larvæ go down deeper into the ground and cover themselves with oval envelopes made of earth and excrement, or secretions from their bodies, and change into chrysalids, from which the beetles emerge in the early part of May. These earthy envelopes, or cocoons, are rough on the outsides.

It has been remarked by some observers of the habits of insects that the larvæ of the green chafer are often found in ants' nests, and upon this an argument has been based to the effect that the larvæ do not eat roots, but feed upon decaying matter. The answer to this is that ants' nests are soft and easily penetrated by the beetles in search of comfortable quarters for their eggs, and that they are very often under trees and the roots of plants. There cannot be any material in the dry composition of an ordinary ants' nest that would serve as food for fleshy larvæ like those of the *Cetoniidæ*. Westwood states that a Brazilian species is said to live upon decaying matter, but he adds that it is "moist rotten wood, almost reduced to a state of decomposition."

Prevention. The beetles are attracted by rubbish and decaying matter that may serve as a cover for their eggs. Therefore it is a most undesirable practice to put long straw or long farmyard manure under strawberry plants. In the case of apple, pear, damson, and other fruit trees it is important that the ground round about them should be kept clean; and upon grass-land all grass and weeds must be kept cleared away within the fences protecting the young trees.

It may be said here that such treatment should always be adopted while the trees are young, as the weeds and herbage that are in so many cases allowed even by enlightened cultivators to grow close around the trees serve as very harbours of refuge for many kinds of insects. For this and for many other reasons, orchards should be kept fed down closely.

Remedies. Should strawberry or raspberry plants show any signs of decay by withering leaves and blossoms drying up, search must be made for foes at the roots. For the larvæ of the *Cetonia* a deep search must be made, as they go down deeply, by digging up the soil with forks or spuds with four broad, flattened prongs. If larvæ are found, the ground between the rows of plants should be deeply dug, with a good dressing of soot applied Ashes, earth well triturated, or

sawdust impregnated with paraffin oil, in the proportion of 1½ pint to a bushel, might be dug in.

With regard to young trees, when it has been discovered that their roots are being injured by these larvæ, the same remedies may be adopted in cultivated land. Upon orchard land, where trees are fenced against stock, strong liquid manure dressings would make the larvæ shift their quarters. Strong soapsuds would make it unpleasant for them if plenteously supplied ('Reports on Insects Injurious to Crops,' by Charles Whitehead, Esq., F.Z.S.).

CETRARIC ACID. $H_2C_{18}H_{14}O_8$. *Syn.* CETRAR'IN. The bitter principle of Iceland moss (*Cetraria Islandica*). It exists in the free state, in the cortical portion of the thallus.

The compounds are called cetrarates.—*Dose*, 2 to 4 gr. every 3 hours, as a febrifuge; 1 to 3 gr. thrice daily as a tonic.

CETYL ALCOHOL. Spermaceti consists of cetyl palmitate, that is cetyl alcohol in combination with palmitic acid.

CEUTHORRHYNCHUS ASSIMILIS, Paykull. The Turnip-seed Weevil. It might be considered that the small seeds of turnips, rape, mustard, and cabbage-plants, would be at least exempt from injury from insects. But there is a very small weevil which attacks even these in the seed-pods while green. Curtis says that three pods of turnip-seed were sent to him, each being punctured by maggots in order to effect their exit. Upon opening these pods he found only 1 seed untouched and 2 slightly eroded: others were half consumed, and many entirely eaten up.

Injury to turnip-plants for seed was reported, in 1884, in Romney Marsh, a district in Kent, where much turnip-seed is grown. Upon investigation, just before the pods were hardening, it was noticed that about 15% of the pods had a tiny hole in them. When these were cut open the seeds were found to be wanting altogether in some instances, and so bitten in others that they were good for nothing. In a few cases where the pods were later, maggots were found within them, evidently still feeding upon the seeds. The grower said that he had noticed little fleas upon the flowers in the summer, but he thought that they were turnip-fleas.

One effect of the action of the maggots of this weevil is that the seeds become prematurely ripe in some cases.

The mischief occasioned by these weevils to the small seeds of cultivated *Cruciferæ* is more extensive than growers realise, and as they are so minute and the chief evidence of their having been in the pods is the small, almost imperceptible hole through which they have escaped, their action is mistaken for failure in fructification, or for disorders of the plant.

This weevil is known to turnip and rape-seed-growers in Germany and in France. Calwer says it is common in Germany, France, and England in the seed-pods of rape (C. G. Calwer's 'Käferbuch'). There is no record of its being known in America.

Life History. The *Ceuthorrhynchus assimilis* (*Ceuthorrhynchus assimilis* is given in Waterhouse's 'Catalogue of British Coleoptera' as synonymous with *C. alauda*, Herbst., *C. obstrictus*, Marsh., Steph., and *C. subrufus*, Marsh.? Steph.) belonging to the family *Curculionidæ* of the COLEOPTERA, is not quite 2 lines, the 1-6th inch, long. The natural colour of it is black, but the thick covering of down or fine hairs upon the upper part of its body causes it to have an ash-grey hue. Its snout, or rostrum, is abnormally long, and is furnished with strong jaws at its extremity. About halfway down this snout there is a pair of 12-jointed antennæ or horns, which have elbows, and terminate in a knob. This snout resembles that of *Balaninus nucum*, and it is supposed that it is applied to the same end, namely, to bore holes in the flower-buds in which to place eggs. The weevils pass the winter in the ground, and under weeds, stones, and rubbish, appearing towards the beginning of May.

The larvæ which come from these eggs are dirty-white, with a dark head, without legs, like the maggots of the nut-weevil, *Balaninus nucum*, but not so large. They are not quite ¼ inch in length. After a time, when food fails or the seed-pods begin to harden, the maggots make a hole in them and fall to the ground, and enwrap themselves in earthen cocoons, in which they remain 3 weeks, Curtis says, and then become weevils. It is presumed that there are 2 broods during the year.

Prevention. As the *Ceuthorrhynchus assimilis* is found upon wild cruciferous plants, especially upon the charlock, *Sinapis arvensis*, and the wild radish, *Raphanus raphanistrum*, and early broods are bred upon these plants, they and all other cruciferous weeds must be extirpated from fields and the outside of fields.

Remedies. The only remedy available is to catch the weevils in bags held under the plants as these are shaken. Curtis in England, and Taschenberg in Germany, both recommend this. It must be practised directly weevils are noticed upon the plants, and before they have time to lay eggs. Curtis says that they should be swept into a pail with lime and water or boiling water, as they have great vitality ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CEUTHORRHYNCHUS SULCICOLLIS, Gyllenhall. The Turnip-gall Weevil. This weevil, though very tiny, is vastly troublesome to turnip, swede, and cabbage plants. It is mischievous in two of its forms. In its weevil state it devours the leafage of the young plants pretty much in the same way as the turnip-flea, *Haltica nemorum.* In its larval, or maggot state it raises up galls or excrescences upon the roots of turnip and cabbage plants, so that they are sometimes seriously affected, and their appearance completely spoiled. Swedes especially are utterly disfigured by the action of this insect; their weight is diminished and their quality deteriorated. The action of the turnip-gall weevil upon the roots is frequently mistaken for constitutional disorders and general unhealthiness of the plants caused by weather or unsuitable conditions of cultivation. For example, it is by no means unusual to hear those who do not observe closely, attribute to Anbury, or "finger and toe," the mischief occasioned by the grubs or maggots of this weevil. Anbury, or "finger and toe," being due, according to physiologists, to degeneracy of the plants, or to reversion to

original stocks. If the galls or swellings upon turnip, swede, and cabbage-roots are cut open, maggots will be seen within them, not unlike the maggots found in nuts, and about the same size. In a field of swedes, upon a light Greensand soil, in Kent, almost every other root had galls upon it, and not only were these found in them in the summer, but also at the end of January, as the swedes were not fed off until very late. There were not very many maggots found at this time; still, some were found, showing that the larvæ, or maggots, of the later broods do undeniably pass the winter in the galls in this country upon turnips as they do upon cabbage-roots, and as they do in Germany, as Taschenberg states ('Praktische Insekten Kunde,' von Dr E. L. Taschenberg).

The maggots of this weevil are constantly found in galls upon the stalks of cabbages, broccoli, cauliflowers, and other varieties of *Brassica oleracea,* at almost all times in the year. They materially check the growth of the plants and render them unhealthy and stunted. Cattle cabbage-plants frequently have galls upon them even when taken out of the 'seed-beds.' These increase and multiply, and tend greatly to reduce the crop.

Considerable harm has been done in some seasons to the young turnip, swede, and cabbage-plants by the weevil itself eating the leaves. Attention was called to this by an observant farmer who said that "some insects like turnip-fleas were eating his swede-plants; but they seemed larger than the ordinary turnip-fleas, though they fed just like these, and had cleared off the plants from many acres." They were afterwards pronounced to be weevils of the *Ceuthorrhynchus sulcicollis* species.

The *Ceuthorrhynchus sulcicollis* is known in Germany, also in France, where it is called *Charançon cou sillonné.*

Life History. This weevil is a species of the genus *Ceuthorrhynchus* (from κεύθω, to conceal; and ῥύγχος, a snout) of the very extensive family *Curculionidæ,* which furnishes foes against most of the crops of the farm, orchard, and garden. It is very small, rather less than 1-6th inch long, with very long snout, out of all proportion to the rest of its body. This is carried between and concealed by its forelegs, whence its name is derived. In colour it is deep black, rather shiny, with a large head and 3 pairs of feet. Its wings are ample and folded in deeply striated elytra. Beneath the upper part of its body there are ash-grey marks.

The weevils come from the pupal state in the beginning of May, and feed upon turnip-plants and wild cruciferous plants, as the charlock, *Sinapis arvensis.* Their eggs are laid in the roots of these plants. Larvæ are soon generated and bore into the root; their irritating action upon it causes a gall to form, in which they live and feed.

The larva is a wrinkled fleshy maggot of a yellowish colour, with a brown head, and without legs. It has a few bristles, or hairs, upon it here and there. Its length is about 1½ lines. Like many of the maggots of weevils and beetles, it lies in a curved form. The larva quits the gall on the roots on which it has been reared, escaping from it after a time by means of a hole bored in it with its strong jaws, as the *Balaninus nucum,* or nut-weevil, bores its way out of a nut. Then it makes itself a case of tiny grains of earth made to adhere to it by a sticky substance which exudes from the larva. The larva remains in this case during the winter, and changes to a pupa in the early spring.

There is more than one brood of these insects during the summer; some of the larvæ of the latest broods remain in the galls during the winter.

Prevention. Where swedes are fed off late it often happens that much of the outside of the roots is left by sheep, especially in bad weather. In cases where the roots are much galled, it would be right to have the pieces that remain after they have been picked up for the sheep, collected and thrown on to a heating mixen. The same remarks apply to all much-galled roots of turnips, or swede-plants, whether fed early or late. Galled roots of cabbage-plants should be got off as far as possible. Plants from seed-beds should be examined for galls. Those that show signs of galls should be rejected. It often happens that the same ground is used over and over again for a 'seed-bed,' and frequently becomes a regular breeding place for injurious insects, which are distributed far and wide with the plants from it.

Charlock and other cruciferous weeds attract this weevil, and should be kept down carefully. Where turnip and cabbage-plants have been affected by this insect these crops should not be taken again for at least two years.

In gardens and market gardens, cabbage, cauliflower, Savoy, and Brussels sprout plants having galls should be pulled up and burnt.

Remedies. When it is ascertained that these weevils are feeding upon the young turnip, swede, or cabbage-plant, soot should be broadcasted over these before the dew is off, or after rain. Lime also has been found serviceable. Ashes, sawdust, or finely triturated and sifted peat moss, saturated with paraffin, may be applied with advantage directly the weevils are seen ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CHABERT'S OIL. *Syn.* Cha'bert's empyreumat'ic oil; O'leum empyreumat'icum Chaberti, O. contra tæniam Chaberti, L. *Prep.* (Ph. Bor. 1847.) From empyreumatic oil of hartshorn, 1 part; oil of turpentine, 3 parts; mix and distil over 3-4ths only in a glass retort, and keep it in well-stoppered bottles. In tapeworm.—*Dose,* 2 teaspoonfuls in water night and morning, until 4 to 6 or even 7 oz. have been taken; a cathartic being also administered from time to time.

CHAFING. See Excoriations.

CHAIRS. The black leatherwork of chairs, settees, &c., may be restored by first well washing off the dirt with a little warm soap-and-water, and afterwards with clean water. The brown and faded portions may now be restored by means of a little black ink, or preferably black reviver, and when this has got thoroughly dry they may be touched over with white of egg, stained and mixed with a little sugar-candy. When the surface is nearly dry it should be polished off with a clean brush.

CHALK. *Syn.* SOFT CARBONATE OF LIME, OR CARBONATE OF CALCIUM, EARTHY C. OF L.; CRE'TA, L. Chalk is largely used in the arts and manufactures, and in medicine. The natural varieties are remarkable for the fossils which they contain. The COLOURED CHALKS which are used as pigments and for crayons generally contain both clay and magnesia, as well as oxide of iron, and are minerals quite distinct from WHITE CHALK, or CHALK properly so called. The latter is an AMORPHOUS CARBONATE OF LIME. Exposed for some time to a red heat, it is converted into QUICKLIME; ground in mills and elutriated, it forms WHITING; the same process performed more carefully and on a smaller scale produces the PREPARED CHALK used in medicine. When prepared artificially (by precipitation), it is the PRECIPITATED CHALK of modern pharmacy (see *below*).

Chalk, Black. A variety of drawing slate.

Chalk, Brown. A familiar name for umber.

Chalk, Cam'phorated. *Syn.* CRETACEOUS TOOTH POWDER, CAM'PHORATED T. P.; CRE'TA CAM'PHORATA, C. CUM CAMPHO'RA, L. *Prep.* 1. Camphor, 1 oz.; add a few drops of spirit of wine, reduce it to a very fine powder, and mix it (perfectly) with precipitated chalk, 7 oz.; lastly, pass it through a clean, fine sieve, and keep it in a corked bottle. These proportions make the strongest 'CAMPHORATED TOOTH POWDER' of the shops.

2. Camphor, 1 oz.; precipitated chalk, 15 oz.; as before. These are the best and safest proportions, and those now generally adopted by the West-end perfumers.

3. As either of the above, but using prepared chalk in lieu of precipitated chalk. Less white and velvety, but cleans the teeth better than the softer article.

Uses, &c. Camphorated chalk is much esteemed as a dentifrice; especially by smokers and those troubled with foul teeth or offensive breath. It may be scented with a few drops (3 or 4 to each oz.) of otto of roses, oil of cloves, or neroli, or of the essences of ambergris, musk, or vanilla; but care must be taken not to overdo it. When the teeth are much furred or discoloured, it may be mixed with about 1-7th of its weight of finely powdered pumice-stone (sifted through lawn), which will render it more effective. A little carmine, rouge, light red (burnt ochre), red coral, or rose pink is also sometimes added to give it a tinge approaching that of the gums. The quantity of camphor (1 to 3 or 4) commonly ordered in certain books is absurdly large, and would render the compound not only unpleasant in use, but actually detrimental to the teeth. See DENTIFRICES.

Chalk, French. Soap-stone or steatite, a soft magnesian mineral, possessing the property of writing on glass. It is used by tailors for marking cloths. Its powder (obtained by scraping) is very soft, velvety, and absorbent of grease. It forms the boot-powder of the boot and shoe makers.

Chalk Mixture. *Syn.* MISTURA CRETÆ, L. Prepared chalk, 1 part; gum arabic (in powder), 1 part; syrup, 2 parts; cinnamon water, 30 parts; mix by trituration.—*Dose*, 1 to 2 oz., with astringent tinctures and opium. Care should be taken to use the prepared chalk as directed; the precipitated chalk has a crystalline character, and is said to occasion irritation of the bowels (*Squire*).

Chalk, Precip'itated. *Syn.* PRECIPITATED CAR'BONATE OF LIME; CRE'TA PRÆCIPITA'TA, CAL'CIS CARB'ONAS PRÆCIPITA'TUM, L. *Prep.* 1. By adding to a solution of chloride of calcium, any quantity, another of carbonate of soda (both cold), and well washing the precipitate with pure water, and drying it out of the dust.

2. (Ph. D.) Solution of chloride of calcium (Ph. D.), 5 parts; carbonate of soda, 3 parts; (dissolved in) water, 4 parts.

3. (B. P.) Dissolve chloride of calcium, 5 oz.; and carbonate of soda, 13 oz.; each in 2 pints of boiling distilled water; mix the two solutions, and allow the precipitate to subside. Collect this on a calico filter, wash it with boiling distilled water until the washing cease to give a precipitate with nitrate of silver, and try the product at the temperature of 212° F.

Uses, &c. It is chiefly employed for making aromatic confection, cretaceous powder, and chalk mixture. When pure it is wholly soluble, with effervescence, in dilute hydrochloric acid (see *below*).

Chalk, Prepa"red. *Syn.* CRE'TA (Ph. E. & Ph. L. 1836), CRE'TA PREPARA'TA (Ph. L. 1851), CRE'TA AL'BA (Ph. D.), L. *Prep.* 1. (Ph. D. 1836.) Rub chalk, 1 lb., with sufficient water, add gradually until reduced to a smooth cream; then stir this into a large quantity of water, and, after a short interval, to allow the coarser particles to subside, pour off the supernatant water (still turbid) into another vessel, and allow the suspended powder to settle; lastly, collect the chalk so prepared and dry it. In the same way shells are prepared, after being first freed from impurities and washed with boiling water.

2. (Commercial; WHI'TING.) On the large scale the chalk is ground in mills, and the elutriation and deposit made in large reservoirs. It is now seldom prepared by the druggist.

Pur. Almost entirely soluble in dilute hydrochloric acid, provided it contains no sulphate of lime or silica, giving off small bubbles of carbonic acid gas.

Test. The salt formed by dissolving the chalk in hydrochloric acid, if rendered neutral by evaporation to dryness and redissolved in water, gives only a very scanty precipitate on the addition of a saccharated solution of lime, indicating absence of phosphate (B. P.).

Uses, &c. In *medicine* as an absorbent, antacid, and desiccant; in acidity, heartburn, dyspepsia, and other like stomach affections, and in diarrhœa, depending on acidity or irritation; in the latter, generally combined with aromatics, astringents, or opium. It forms a valuable dusting powder in excoriations, ulcers, &c., especially in those of children.—*Dose*, 10 gr, to a spoonful, in a little water or milk, or made into a mixture with mucilage or syrup.

Chalk, Red. A natural clay containing about 18% of protoxide and carbonate of iron.

CHALYB'EATES. *Syn.* CHALYBEA'TA, FERRUGIN'EA, L. The medicinal qualities of the

preparations of iron are noticed under the name of that metal. Those most frequently employed in medicine are—IRON FILINGS; QUEVENNE'S IRON; the BLACK OXIDE, MAGNETIC OXIDE, and SESQUIOXIDE OF IRON; the AMMONIO-CHLORIDE and SESQUICHLORIDE; the CARBONATE and SACCHARINE CARBONATE; the CITRATE and AMMONIO-CITRATE; the IODIDE, LACTATE, and SULPHATE; the TARTRATE, AMMONIO-TARTRATE, and POTASSIO-TARTRATE OF IRON; and the CHALYBEATE MINERAL WATERS. For the doses, &c., see the respective articles.

CHAM'OMILE. *Syn.* AN'THEMIS, L. The flowers of the *Anthemis nobilis* (*Anthemidis flores,* B. P.). They are bitter, stomachic, and tonic; in dyspepsia, loss of appetite, intermittents, &c. They are said to be an effectual remedy for nightmare; and, according to Dr Schall, the only certain remedy for that complaint.—*Dose,* 10 gr. to ½ dr., or more, in powder or made into a tea. Fomentations are also made with it. See EXTRACTS, OILS, PILLS, &c.

CHAMPAGNE. See WINES.

CHAPS. These are too well known to require description. Chapped hands are common amongst persons with a languid circulation, who are continually 'dabbling' in water during cold weather. Chapped lips generally occur in persons with pallid, bluish, moist lips, who are much exposed to the wind in dry cold weather; especially in those who are continually moving from heated apartments to the external air. The application of a little COLD CREAM, POMATUM, SPERMACETI OINTMENT, LARD, or any similar article, will generally prevent chaps on the lips, and chaps and chilblains on the hands. Persons employed in oil and tallow works, or about oil, and who have consequently their hands continually in contact with greasy matter, never suffer from them. A little oil or unguent of any kind, well rubbed on the hands on going to rest (removing the superfluous portion with a cloth), will not only preserve them from cold, but tend to render them both soft and white. See CHILBLAIN.

CHAR (Potted). The flesh of the *Salmo alpinus,* Linn., or trout of the Alps, common in the lakes of Lapland, preserved by the common process of potting.

CHARÆAS GRAMINIS, Stephens. The Antler-moth. The antler-moth, so called because of the markings of its fore-wings, resembling the branches of antlers, occasionally ravages meadow-land. Its attacks have increased in parts of England in the last five years, and in Wales also. For example, there was much injury caused by them in 1882 in the grass-lands on an area of about 10 miles not far from Bridgend. Curtis speaks of the *Charæas* as hurting grass-land in Keswick, and relates that the grass on a large portion of one side of Skiddaw appeared dead, and multitudes of the caterpillars of the antler-moth were crawling about. They eat the shoots of the grass as well as the roots.

Taschenberg says that these are sometimes most destructive in Germany and North America. In Sweden, so long ago as 1741, their ravages were so great as to be almost a national calamity. It appears that the attacks of this insect are principally confined to grass-land in high situations, and especially to rough pastures and to mountain districts. Köllar relates that in 1816 and 1821 entire hills in the Hartz territory which were covered in the evening with the finest green were found bare the next morning, and the ruts in the roads leading to them were filled with caterpillars.

Life History. This moth has broad and rather short upper, or fore-wings of a reddish brown with three light or whitish streaks or rays; while the lower wings are yellowish-grey with pale fringes. In the summer the moths may be seen in some places in swarms, and the caterpillars appear also to congregate and move in masses like locusts, clearing away the vegetation as they proceed.

The female moth lays from 150 to 200 eggs in small quantities at a time upon the stalks and blades of grasses. After 3 weeks the larvæ come forth and go into the ground and live on the roots of grasses, hibernating in this state, and changing to the pupa and moth forms in the summer.

Prevention. After the appearance of numbers of these moths in any locality it would be well to brush off all rough herbage upon which the eggs might have been placed, and burn it before the hatching took place.

Remedies. As the caterpillars have a habit of advancing in battalions, and it is in this manner only that they are productive of serious harm, the rough grass should be set alight in front of the hosts, so as to check their progress. This should be done at night, as the caterpillars move and feed then. Köllar suggests that the attacked places, where the ground permits, should be surrounded with shallow ditches, or furrows, made deeply with ploughs and as broad as possible, to check them. Pigs, he adds, should be turned into these enclosures to eat the caterpillars ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CHARBON ROUX. See CHARCOAL.

CHARCOAL. Charcoal is made by charring organic substances, such as wood, bones, blood, &c. It forms, in fact, the residue left when vegetable or animal matter is exposed to a high temperature out of contact with air. There are several varieties of charcoal, the chief of these being wood and animal charcoal.

Charcoal, Animal. *Syn.* ANIMAL-BLACK, BONE-BLACK, IVORY-BLACK, CARBO ANIMALIS, L.; CHARBON ANIMAL, Fr.; THIERKOHLE, Ger. This is obtained by charring bones in iron cylinders or retorts, and is formed as a by-product in the manufacture of Dipple's animal oil. It consists largely of calcium phosphate and carbonate, and contains about 10% of carbon disseminated throughout the mass. During the process of charring the bones lose about half their weight.

Commercial. Bones (deprived of their grease by boiling) are broken to pieces, and put into small cast-iron pots, varying from ⅜ to ½ inch in thickness. Two of these being filled, are dexterously placed with their mouths together, and then luted with loam. A number of these vessels are then placed side by side and piled on each other, in an oven resembling a potter's kiln, to the number of 100 or 150, or even more. The fire is next kindled, and the heat kept up strongly for

10 or 12 hours, according to circumstances, until the process is completed. The whole is then allowed to cool before opening the pots.

A more economical method is by distillation as under:

Bones (previously boiled for their grease) are introduced into retorts similar to those used in gas-works, and heat being applied, the volatile products are conveyed away by iron pipes to cisterns where the condensable portion is collected. As soon as the process of distillation is finished, the solid residuum in the retorts, while still red hot, is removed through their lower ends into wrought-iron canisters, which are instantly closed by air-tight covers and luted over. These are then raised to the ground by a crane, and set aside to cool.

The bones, having been carbonised, are ground in a mill, and the resulting coarse powder sorted by sieves into 2 kinds, 1 granular, somewhat resembling gunpowder, for decolourising liquids, and the other, quite as fine, to be used as a pigment. The first is sold under the name of animal charcoal; the second as bone or ivory-black. The latter and other fine varieties of animal charcoal are fully described under the head of BLACK PIGMENTS.

Uses, &c. This crude animal charcoal possesses the valuable property of taking lime and other saline matter from syrups and other aqueous solutions, especially organic ones, at the same time that it decolours them. Its power as a decolouriser may be tested by adding it to a solution of brown sugar or of molasses, or to water containing 1-1000th part of indigo dissolved in sulphuric acid. The test should be made in a small glass tube. By well washing and carefully reburning it, this charcoal may be used any number of times. As a decolouriser and deodoriser, animal charcoal is vastly superior to vegetable charcoal. It is largely used in sugar refining to decolourise and purify the syrup.

Dr Stenhouse has invented a charcoal respirator to cover over the mouth and nostrils of a person going into an infected atmosphere. Charcoal is also used with excellent effect to prevent the escape of noxious vapours and offensive effluvia from the ventilating openings of sewers. The charcoal condenses and oxidises the escaping sewer-gas in its pores. Dr Garrod has proposed animal charcoal as a general antidote in cases of poisoning.

Charcoal, Prepared Animal. *Syn.* CARBO ANIMALIS PURIFICATUS. B. P. Mix 10 fl. oz. hydrochloric acid (sp. gr. 1·16) with a pint of distilled water, and add 1 lb. bone-black, stirring occasionally. Digest at a moderate temperature for two days, agitating from time to time; collect the undissolved charcoal on a calico filter, and wash with diluted water until what passes through gives scarcely any precipitate with nitrate of silver. Dry the charcoal, and then heat it to redness in a covered crucible. It is used to decolourise syrups, &c., and occasionally by the distillers and rectifiers.

The most powerful charcoal is prepared by calcining blood, and well washing the residue, and which is the method of the last London Pharmacopœia. The B. P. directs it to be made by burning bones in a closed vessel.

Concluding Remarks. Animal charcoal, however prepared, if intended to be used as a deodoriser or decolouriser, should be kept thoroughly excluded from the air, as by exposure it loses all its valuable properties, and becomes absolutely inert. Freshly burnt charcoal is therefore to be be employed wherever it can be obtained.

Charcoal, Wood. *Syn.* VEGETABLE CHARCOAL; CARBO LIGNI, L.; CHARBON DE BOIS, Fr.; HOLZKOHLE, Ger. The residue obtained when wood is heated in the absence of air, or burned in an insufficient supply of air. It contains usually about 86% carbon, 4% of hydrogen, oxygen, and nitrogen, 3% of ash, and 7% of water. It is extremely porous, and retains the structure of the wood from which it is derived. Wood yields from 10% to 15% of charcoal, and this charcoal, in consequence of the air in its pores, has a sp. gr. of only 0·1 to 0·2, and floats easily upon water; if, however, the air is displaced from the pores it at once sinks.

Charcoal burning is effected on the Continent in the open air by slowly burning the wood in piles or stacks, covered with earth or sods. In countries like our own, where wood is scarce, it is obtained from small wood or sawdust by carbonising it in cast-iron retorts. By this process not only is charcoal obtained, but volatile products, especially wood spirit, pyroligneous acid and tar, are collected, and indeed it is to obtain these substances that the process is worked, the charcoal being but a bye-product.

CHARCOAL FOR FUEL, &c. The method of pile burning is that which is most extensively practised. Pieces of wood of equal length are piled concentrically round a sort of chimney formed by driving 3 stakes in the ground: those nearest the centre almost vertical, and the surrounding pieces have a slight but gradually increasing inclination; a second row, and in the case of very large piles even a third, may be stacked in a similar manner one above the other. The pile is covered with turf and soil, and kindled by filling the space within the 3 central stakes with easily inflammable wood, which is ignited. The character of the smoke which issues from vents made in the piles indicates exactly the degree of carbonisation in different parts. When the charcoal is drawn from the pile it is extinguished by cold water, or if that is not at hand, by charcoal dust or dry soil. In some parts of Sweden the wood is charred in large rectangular stacks, and in China the method of charring in pits is practised.

CHARCOAL FOR GUNPOWDER; CYLINDER CHARCOAL. The charcoal employed in the manufacture of gunpowder is burnt in close iron cylinders, and has hence received the name of cylinder charcoal. For this and other nice purposes it is essential that the last portion of the tar and vinegar should be suffered to escape, and the reabsorption of the crude vapours prevented by cutting off the communication between the cylinders and the condensing apparatus, as without this precaution, on the fire being withdrawn, a retrograde movement of the product takes place, and the charcoal is much reduced in quality. Alder and willow are the woods chiefly used for making charcoal at Waltham Abbey. The Dutch

white willow, and after that the Huntingdon willow, are said to yield the best charcoal for gunpowder. The charcoal from the cylinders of the pyroligneous acid (wood vinegar) works is also called cylinder charcoal, and is that chiefly used for chemical purposes; but it is inferior to that prepared for gunpowder.

Charcoal for Scientific Purposes. The box-wood charcoal, employed in voltaic electricity, is prepared by putting prismatic pieces of box-wood, about 1 inch long by ½ inch thick, into a crucible, which is then filled with clean dry sand, covered up, and exposed to a red heat for about an hour.

Uses, &c. These are numerous and varied. Charcoal is extensively employed as a fuel; and in *metallurgy* for tempering metals, making steel, &c.; reduced to a powder, it is used to surround vessels and bodies required to retain their heat for some time; a coating of charcoal, formed on piles and stakes of wood by charring them, promotes their preservation. Fresh-burnt charcoal, in coarse powder, restores tainted meat and putrid water, discolours vegetable solutions, deodorises fetid substances, and withdraws lime from syrups filtered through it. Exposed on trays it is used as a disinfectant and deodoriser in the wards of hospitals, and in dissecting-rooms; also as a material for water-filters.

In *medicine*, charcoal is principally used as a deodoriser and disinfectant, either in the form of powder, or made up into a poultice. It has been given internally in dyspepsia, diarrhœa, dysentery, heartburn, agues, constipation, sickness of pregnancy, and various other diseases, with advantage. As a prophylactic of cholera and fevers it is invaluable and superior to all other substances. It forms the best tooth-powder known, as it both whitens the teeth and deodorises the breath.—*Dose*, 10 gr. to a teaspoonful, or more *ad libitum.* An ointment made with lard and charcoal has been successfully employed in some skin diseases. In all cases, to be useful, the charcoal must be both freshly burned and freshly powdered, and carefully preserved out of contact with the air until about to be administered. Fresh carbonised bread forms an excellent charcoal both for a prophylactic and a toothpowder.

Charcoal varies in its qualities according to the substance from which it is prepared; that of the soft woods (willow or alder) is best for crayons and gunpowder, that of the hard woods for fuel and for blowpipe supports. That made by a low red heat not exceeding cherry-red, and which has a dull surface, is the most valuable. If the heat be carried much beyond this point the charcoal acquires a brilliant surface, and deteriorates in quality. Chestnut charcoal is preferred by smiths for forging, as it not only burns slowly, but deadens as soon as the blast ceases. Areca-nut charcoal is preferred as a dentifrice, but the willow charcoal or boxwood charcoal is usually substituted for it by shopkeepers.

Ant., &c. Poisoning or suffocation resulting from respiring the fumes of charcoal has been already alluded to, and the treatment briefly pointed out. See Carbonic Anhydride and Poisoning.

CHAR'GES (for Cattle). See Veterinary Medicine.

CHAR'RING (Surface). The operation by which the surface of wood is carbonised, to prevent its decay from exposure to air and moisture. Stakes and piles are generally thus treated before they are driven into the ground. Casks are charred on the inside by coopers when they are intended to hold water. In both these cases the fire is commonly applied directly to the wood. A new method has, however, been lately employed with apparent success. This consists in washing the wood with the strongest oil of vitriol. In this way not only the outer surface, but the surface of all the cracks and holes, get carbonised, which is not the case when heat is employed. It succeeds admirably with musty casks and vats.

CHATHAM LIGHT. A flash-light used for military signals. It is produced by blowing a mixture of pulverised resin and magnesium dust through the flame of a spirit lamp.

CHAYOTE or CHOCO (*Sechium edule*, Sw.). A tree of Mexico and Venezuela. The fruits are eaten and are occasionally sold in Covent Garden Market.

CHAYOTILLA (*Hanburia mexicana,* Seem.). A Mexican climbing plant.

CHEESE. *Syn.* Ca'seum, Ca'seus, L. The curd of milk compressed into a sold mass. That of commerce is usually salted and dried, and in some varieties it is also coloured and flavoured.

The process of cheese-making is one which is eminently interesting and scientific, and which, in every gradation, depends on principles which chemistry has developed and illustrated. When a vegetable or mineral acid is added to milk, and heat applied, a coagulum is formed, which, when separated from the liquid portion, constitutes cheese. Neutral salts, earthy and metallic salts, sugar, and gum arabic, as well as some other substances, also produce the same effect; but that which answers the purpose best, and which is almost exclusively used by dairy farmers, is rennet, or the mucous membrane of the last stomach of the calf. Alkalies dissolve this curd at a boiling heat, and acids again precipitate it. The solubility of casein in milk is occasioned by the presence of the phosphates and other salts of the alkalies. In fresh milk these substances may be readily detected by the property it possesses of restoring the colour of reddened litmus-paper. The addition of an acid neutralises the alkali, and so precipitates the curd in an insoluble state. The philosophy of cheese-making is thus expounded by Liebig:

"The acid indispensable to the coagulation of milk is not added to the milk in the preparation of cheese, but it is formed in the milk at the expense of the milk-sugar present. A small quantity of water is left in contact with a small quantity of a calf's stomach for a few hours, or for a night; the water absorbs so minute a portion of the mucous membrane as to be scarcely ponderable; this is mixed with milk; its state of transformation is communicated (and this is a most important circumstance), not to the cheese, but to the milk-sugar, the elements of which transpose themselves into lactic acid, which neutralises the alkalies, and thus causes the separation of the cheese. By means of litmus-paper the process may be followed and observed through all its

stages; the alkaline reaction of the milk ceases as soon as the coagulation begins. If the cheese is not immediately separated from the whey, the formation of lactic acid continues, the fluid turns acid, and the cheese itself passes into a state of decomposition.

"When cheese-curd is kept in a cool place a series of transformations takes place, in consequence of which it assumes entirely new properties; it gradually becomes semi-transparent, and more or less soft, throughout the whole mass; it exhibits a feebly acid reaction, and develops the characteristic caseous odour. Fresh cheese is very sparingly soluble in water, but after having been left to itself for 2 or 3 years it becomes (especially if all the fat be previously removed) almost completely soluble in cold water, forming with it a solution which, like milk, is coagulated by the addition of the acetic or any mineral acid. The cheese, which whilst fresh is insoluble, returns during the maturation, or ripening, as it is called, to a state similar to that in which it originally existed in the milk. In those English, Dutch, and Swiss cheeses which are nearly inodorous, and in the superior kinds of French cheese, the caseine of the milk is present in its unaltered state.

"The odour and flavour of the cheese is owing to the decomposition of the butter; the non-volatile acids, the margaric and oleic acids, and the volatile butyric acid, capric and caproic acids are liberated in consequence of the decomposition of glycerin. Butyric acid imparts to cheese its characteristic caseous odour, and the differences in its pungency or aromatic flavour depend upon the proportion of free butyric, capric, and caproic acids present." In the cheese of certain dairies and districts, valerianic acid has been detected along with the other acids just referred to. Messrs. Jljenko and Laskowski found this acid in the cheese of Limbourg, and M. Bolard in that of Roquefort.

"The transition of the insoluble into soluble casein depends upon the decomposition of the phosphate of lime by the margaric acid of the butter; margarate of lime is formed, whilst the phosphoric acid combines with the casein, forming a compound soluble in water.

"The bad smell of inferior kinds of cheese, especially those called meagre or poor cheeses, is caused by certain fetid products containing sulphur, and which are formed by the decomposition or putrefaction of the casein. The alteration which the butter undergoes (that is, in becoming rancid), or which occurs in the milk-sugar still present, being transmitted to the casein, changes both the composition of the latter substance and its nutritive qualities.

"The principal conditions for the preparations of the superior kinds of cheese (other obvious circumstances being of course duly regarded) are a careful removal of the whey, which holds the milk-sugar in solution, and a low temperature during the maturation or ripening of the cheese."

Cheese differs vastly in quality and flavour, according to the method employed in its manufacture and the richness of the milk of which it is made. Much depends upon the quantity of cream it contains, and consequently, when a superior quality of cheese is desired, cream is frequently added to the curd. This plan is adopted in the manufacture of Stilton cheese and others of a like description. The addition of a pound or two of butter to the curd for a middling-sized cheese also vastly improves the quality of the product. To ensure the richness of the milk, not only should the cows be properly fed, but certain breeds chosen. Those of Alderney, Cheddar, Cheshire, Gloucestershire, Guernsey, and North Wiltshire deserve a preference in this respect.

The materials employed in making cheese are milk and rennet. Rennet is used either fresh or salted and dried; generally in the latter state. The milk may be of any kind, according to the quality of the cheese required. Cows' milk is that generally employed; but occasionally ewes' milk is used; and sometimes, though more rarely, that from goats.

In preparing his cheese, the dairy farmer puts the greater portion of the milk into a large tub, to which he adds the remainder, sufficiently heated to raise the temperature to that of new milk. The whole is then whisked together, the rennet or rennet liquor added, and the tub covered over. It is now allowed to stand until completely 'turned,' when the curd is gently struck down several times with the skimming-dish, after which it is allowed to subside. The vat covered with cheese-cloth is next placed on a 'horse' or 'ladder' over the tub, and filled with curd by means of the skimmer, care being taken to allow as little as possible of the oily particles or butter to run back with the whey. The curd is pressed down with the hands, and more added as it sinks. This process is repeated until the curd rises to about 2 inches above the edge. The newly formed cheese, thus partially separated from the whey, is now placed in a clean tub, and a proper quantity of salt added, as well as of annotta, when that colouring is used, after which a board is placed over and under it, and pressure applied for about 2 or 3 hours. The cheese is next turned out and surrounded by a fresh cheese-cloth, and then again submitted to pressure in the cheese-press for 8 or 10 hours, after when it is commonly removed from the press, salted all over, and again pressed for 15 to 20 hours. The quality of the cheese especially depends on this part of the process, as if any of the whey is left in the cheese it rapidly becomes bad-flavoured. Before placing it in the press the last time the common practice is to pare the edges smooth and sightly. It now only remains to wash the outside of the cheese in warm whey or water, to wipe it dry, and to colour it with annotta or reddle, as is usually done.

The storing of the newly made cheese is the next point that engages the attention of the maker and wholesale dealer. The same principles which influences the maturation or ripening of the fermented liquors also operate here. In England, a cool cellar, neither damp nor dry, and which is uninfluenced by change of weather or season, is commonly regarded as the best for the purpose. If possible, the temperature should on no account be permitted to exceed 50° or 52° F. at any portion of the year. An average of about 45° is preferable when it can be procured. A place

exposed to sudden changes of temperature is as unfit for storing cheese as it is for storing beer. "The quality of Rochefort cheese, which is prepared from sheep's milk and is very excellent, depends exclusively upon the places where the cheeses are kept after pressing and during maturation. These are cellars, communicating with mountain grottoes and caverns, which are kept constantly cool, at about 41°—42° F., by currents of air from clefts in the mountains. The value of these cellars as storehouses varies with their property of maintaining an equable and low temperature. Giron mentions that a certain cellar, the construction of which had cost only £480 (12,000 francs), was sold for £8600 (215,000 francs), being found to maintain a suitable temperature, a convincing proof of the importance attached to temperature in the preparation of these superior cheeses" (*Liebig*).

It will thus be seen that very slight differences in the materials, in the preparation, or in storing of the cheese, materially influence the quality and flavour of this article. The richness of the milk—the addition to or subtraction of cream from the milk—the separation of the curd from the whey with or without compression—the salting of the curd—the collection of the curd, either whole or broken, before pressing—the addition of colouring matter, as annotta or saffron, or of flavouring—the place and method of storing—and the length of time allowed for maturation, all tend to alter the taste and odour of the cheese in some or other particular, and that in a way readily perceptible to the palate of the connoisseur. No other alimentary substance appears to be so seriously affected by slight variations in the quality of the materials from which it is made, or by such apparently trifling differences in the methods of preparing it.

Var. The varieties of cheese met with in commerce are very numerous, and differ greatly from each other in richness, colour, and flavour. These are commonly distinguished by names indicative of the places in which they have been manufactured, or of the quality of the materials from which they have been prepared. Thus, we have Dutch, Gloucester, Stilton, skimmed-milk, raw-milk, cream, and other cheeses; names which explain themselves. The following are the principal varieties met with in Europe:

Cheese, Brickbat. From its form; made in Wiltshire of new milk and cream.

Cheese, Cheddar. A fine, spongy kind of cheese, the eyes or vesicles of which contain a rich oil; made up into round, thick cheeses, of considerable size (150 to 200 lbs.).

Cheese, Cheshire. From new milk, without skimming, the morning's milk being mixed with that of the preceding evening, previously warmed, so that the whole may be brought to the heat of new milk. To this the rennet is added, in less quantity than is commonly used for other kinds of cheese. On this point much of the flavour and mildness of the cheese is said to depend. A piece of dried rennet, of the size of half-a-crown, put into a pint of water overnight, and allowed to stand until the next morning, is sufficient for 18 or 20 galls. of milk. In large, round, thick cheeses (100 to 200 lbs. each). They are generally solid, homogeneous, and dry, and friable rather than viscid.

Cheese, Cottenham. A rich kind of cheese, in flavour and consistence not unlike Stilton, from which, however, it differs in shape, being flatter and broader than the latter.

Cheese, Cream. From the 'strippings' (the last of the milk drawn from the cow at each milking), from a mixture of milk and cream, or from raw cream only, according to the quality desired. It is usually made in small oblong, square, or rounded cakes, a gentle pressure only (that of a 2 or 4 lb. weight) being applied to press out the whey. After 12 hours it is placed upon a board or wooden trencher, and turned every day until dry. It ripens in about three weeks. A little salt is generally added, and frequently a little powdered lump-sugar.

Cheese, Derbyshire. A small, white, rich variety, very similar to Dunlop cheese.

Cheese, Dunlop. Rich, white, and buttery; in round forms, weighing from 30 lbs. to 60 lbs.

Cheese, Dutch. (Holland.) Of a globular form; 5 to 14 lbs. each. Those from Edam are very highly salted; those from Gouda less so.

Cheese, Gloucester. Single Glo'ster; from milk deprived of part of its cream; Double Glo'ster, from milk retaining the whole of the cream. Mild tasted, semi-buttery consistence, without being friable; in large, round, flattish forms.

Cheese, Green or Sage. From milk mixed with the juice or an infusion or decoction of sage leaves, to which marigold flowers and parsley are frequently added.

Cheese, Gruyère. A fine description of cheese made in Switzerland, and largely consumed on the Continent. It is firm and dry, and exhibits numerous cells of considerable magnitude. Its flavour is peculiar, and is not generally liked by English people.

Cheese, Lincoln. From new milk and cream; in pieces about 2 inches thick; soft, and will not keep over 2 or 3 months.

Cheese, Neufchâtel. A much-esteemed variety of Swiss cheese; made of cream, and weighs about 5 or 6 oz.

Cheese, Norfolk. Dyed yellow with annotta or saffron; good, but not superior; in cheeses of 30 lbs. to 50 lbs.

Cheese, Parmesan. (Parma, &c.) From the curd of skimmed milk, hardened by a gentle heat. The rennet is added at about 120° F., and an hour afterwards the curdling milk is set on a slow fire until heated to about 150° F.; during which the curd separates in small lumps. A few pinches of saffron are then thrown in. About a fortnight after making the outer crust is cut off, and the new surface varnished with linseed oil, and one side coloured red. Parmesan cheese is the kind which should be used for macaroni and cheese. If for eating in the usual way, this cheese should be freshly cut, otherwise it is very dry and hard.

Cheese, Roquefort. From ewes' milk; the best prepared in France. It greatly resembles Stilton, but is scarcely of equal richness or quality, and possesses a peculiar pungency and flavour.

Cheese, Slipcoat or Soft. A very rich white

cheese, somewhat resembling butter; for present use only.

Cheese, Stilton. The richest and finest cheese made in England. From raw milk to which cream taken from other milk is added; in cheeses generally twice as high as they are broad. Like wine, this cheese is vastly improved by age, and is therefore seldom eaten before it is 2 years old. A spurious appearance of age is sometimes given to it by placing it in a warm damp cellar, or by surrounding it with masses of fermenting straw or dung.

Cheese, Suffolk. From skimmed milk; in round flat forms, from 24 lbs. to 30 lbs. each. Very horny and heavy.

Cheese, Swiss. The principal cheeses made in Switzerland are the Gruyère, the Neufchâtel, and the Schabzieger or green cheese. The latter is flavoured with melilot.

Cheese, Westphalian. In small balls or rolls of about 1 lb. each. It derives its peculiar flavour from the curd being allowed to become partially putrid before being pressed.

Cheese, Wiltshire. Resembles poor Cheshire or Glo'ster. The outside is generally painted with a mixture of reddle or red-ochre or whey.

Cheese, York. From cream; it will not keep.

Qual., &c. Cheese has been objected to as an article of diet, but without sufficient reason, since it is, when of good quality, eminently nutritious, wholesome, and digestible. Like all other food, cheese digests more readily when well masticated, and the neglect of this precaution is one reason why it frequently disagrees with delicate stomachs. It is rendered more agreeable to many palates by toasting it, but becomes less digestible by that operation. The basis of cheese is casein or coagulated curd, a protein substance; it therefore cannot fail to prove nutritious, provided it is properly digested. Cheese-curd, carefully freed from water and milk by expression, and the addition of salt, is a mixture of casein and butter. It contains all the phosphate of lime and part of the phosphate of soda of the milk (*Liebig*). When taken as a condiment, especially when rich and old, it powerfully promotes the secretion of the saliva and gastric juice, and thereby aids the stomach in performing its proper functions. Rotten cheese is very unwholesome.

We give below the composition of some of the principal varieties of cheese:

	Cheddar.	Double Gloucester.	Skim.
Water	36·64	35·61	43·64
Casein	23·38	21·76	45·64
Fatty matter	35·44	38·16	5·76
Mineral matter	4·54	4·47	4·96
	100·00	100·00	100·00

	Stilton.	Cotherstone.
Water	32·18	38·28
Butter	37·36	30·89
Casein	24·31	23·93
Milk-sugar and extractive matter	2·22	3·70
Mineral matter	3·93	3·20
	100·00	100·00

	Gruyère.	Ordinary Dutch.
Water	40·00	36·10
Casein	31·50	29·40
Fatty matter	24·00	27·50
Salts	3·00	·90
Non-nitrogenous organic matter and loss	1·50	6·10
	100·00	100·00

Concluding Remarks. It is surprising that cheese is not more frequently made an article of domestic manufacture, especially by housewives resident in the country. The operations of cheese-making are all exceedingly simple, and not laborious, and will, in most cases, amply repay the outlay for the milk. Besides, cheese is not unfrequently coloured with stains and pigments which are injurious, and even poisonous, the risk of taking which is not encountered when it is made at home. Several persons have nearly lost their lives from eating cheese coloured with annotta, for instance. This substance, though harmless in itself, is frequently adulterated with red-lead, so that the cheesemonger may very innocently introduce a poison, when he only intends to improve the colour of his goods.

When a whole cheese is cut, and the consumption small, it is generally found to become unpleasantly dry, and to lose flavour before it is consumed. This is best prevented by cutting a sufficient quantity for a few days' consumption from the cheese, and keeping the remainder in a cool place, rather damp than dry, spreading a thin film of butter over the fresh surface, and covering it with a cloth or pan to keep off the dirt. This removes the objection existing in small families against purchasing a whole cheese at a time. The common practice of buying small quantities of cheese should be avoided, as not only a higher price is paid for any given quality, but there is little likelihood of obtaining exactly the same flavour twice running. Should cheese become too dry to be agreeable it may be used for stewing, or for making grated cheese, or Welsh rare-bits.

CHEESE, APPLE. The pomace or ground apples from the cider press.

CHEESE, DAMSON. *Prep.* From damsons boiled with a little water, the pulp passed through a sieve, and then boiled with about 1-4th the weight of sugar, until the mixture solidifies on cooling; it is next poured into small tin moulds previously dusted out with sugar. Cherry cheese, gooseberry cheese, plum cheese, &c., are prepared in the same way, using the respective kinds of fruit. They are all very agreeable candies or confections.

CHEESE, FACTI'TIOUS ROQUE'FORT. *Prep.* (*Roulle*). The gluten of wheat is kneaded with a little salt, and a small portion of a solution of starch, and made up into cheeses. It is said that this mixture soon acquires the taste, smell, and unctuosity of cheese, and when kept a certain time is not to be distinguished from the celebrated Roquefort cheese, of which it possesses all the peculiar pungency. By slightly varying the process other kinds of cheese may be imitated.

CHEESE, LEGUMIN. The Chinese prepare an actual cheese from peas, called "tao-foo," which they sell in the streets of Canton. The paste

from steeped ground peas is boiled, which causes the starch to dissolve with the casein; after straining the liquid it is coagulated by a solution of gypsum; this coagulum is worked up like sour milk, salted, and pressed into moulds.

CHEESE, TOASTED. This much-relished article is seldom well prepared. The following has been recommended as an excellent receipt: Cut the cheese into slices of moderate thickness, and put them into a tinned copper saucepan, with a little butter and cream; simmer very gently until they are quite dissolved, then remove the saucepan from the fire, allow the whole to cool a little, add some yelk of egg, well beaten, add spice, make the compound into a 'shape,' and brown it before the fire. See FONDUE.

CHEIMATOBIA BRUMATA, Stephens. The Winter-moth. It may be stated with much emphasis that the winter-moth is a typical instance of the great necessity for the dissemination of entomological knowledge, as it is so insignificant in appearance and withal is most mischievous and insidious in the manner of its operations. Yet there are simple precautionary measures tending to prevent its attack or to lessen it in an important degree, if these were generally known and carried out properly and at the nick of time.

As in all the species of *Lepidopterous* insects, the chief mischief occasioned by this winter-moth is done by its larvæ or caterpillars. Its attentions are by no means confined to apple trees, for in some seasons it causes great harm to pear trees, plum, damson, and bullace trees, as well as to peach and apricot trees, and gooseberry and currant bushes. Filbert and cob-nut trees also suffer frequently from it, especially those set under apple trees.

Its method of injury is in this wise. Directly there is the slightest indication of the bursting forth of leaf-buds and fruit-buds of the trees and bushes the caterpillars begin to feed upon them, and continue to devour them until the blossoms are useless for fruit production, and the leaves are so injured that they cannot perform their functions. In the case of plum and damson trees in which the blossom buds are somewhat more forward than the leaf buds and are the special objects of the attack of this insect, upon examination of these trees when the first indication of blossoming appears it will be found that very tiny thread-like caterpillars are eating the flower-buds. They consume the vital parts of these, spreading silken webs from petal to petal after the buds have expanded, in order to form a kind of shelter. Leaf-buds are treated in the same manner.

In 1868 and 1869 there was much havoc caused by these caterpillars in the apple and pear orchards of Herefordshire and Worcestershire, and in the same year the damson trees in Kent were infested with them and the crop was materially lessened. In later years there have been occasional visitations in various parts of the fruit-growing counties of this country. Gooseberry and currant bushes are also very liable to receive injury from the caterpillars of the winter-moth, and it is by no means uncommon to find that their evil work is attributed to the much more common gooseberry saw-fly, *Nematus ribesii*, or to the gooseberry-moth, *Abraxas grossulariata*.

In the Kentish filbert plats the winter-moth appears specially to revel among the sweet young leaves and delicate 'bloom' within the whorls of the leaves.

This insect is known in America, and Canada has an insect closely resembling it in appearance, habits, and injurious effects. It is known there as the *Anisopteryx pometaria*. Harris, Fitch, Riley, Lintner, and Saunders speak of this as the 'canker-worm,' and state that it is most troublesome to the growers of many kinds of fruits.

From the writings of German entomologists and practical fruit growers it is evident that this moth causes even much more destruction in German than in English fruit plantations. Köllar has a long and elaborate monograph of it ('Naturgeschichte der schädlichen Insektens,' von V. Köllar), and Kaltenbach and Taschenberg describe it and its mishief at length.

It is also well known in France.

Life History. The winter-moth is a *Lepidopterous* insect of the family *Geometridæ*, so called from the peculiar mode of progression of its larvæ, as of measuring distance at each step. It is called 'winter-moth' because it does not emerge from the chrysalis state until November, and may be found in mild winters until the end of December.

Like many others of the moths which injure crops, it is of nocturnal habit, coming forth from its retreat when twilight begins and resting quietly thoughout the day.

The male is about 14 lines across its wing expanse, and is of a reddish-grey colour with dark though somewhat indistinct marks upon its forewings. Its body is about 6 lines in length. It may be seen in November evenings flying in search of the female, which is wingless, or has only rudimentary wings not adapted for flight, and is found upon the stems of trees and upon fences, or upon grasses and weeds. The female is of most peculiar shape, and is not at all like a moth. It is of a brown or tawny colour, about 5 lines long, with a distended squat body and very short wings utterly unsuited for flying. In these circumstances the female remains usually not very far off from the place where the chrysalis state was passed.

Soon after pairing has been accomplished, generally about the second week in November, the female places her tiny green eggs one by one upon the buds of fruit trees or upon the twigs near them. According to some naturalists a female lays from 200 to 250 eggs. From these eggs caterpillars are hatched about the middle of April, and they immediately begin to feed upon flower and leaf buds, even before they burst forth. Often they can be found later on within the expanded calyces of the blossoms whose petals they have joined together with silken strings. When full grown these caterpillars are rather more than 6 lines, or ½ an inch in length; they are of a pale green colour with faint lines or stripes running along the upper part of the body. Having no abdominal legs, they cannot crawl along evenly, as caterpillars of other species, but, like all those of the *Geometridæ*, they make progress by moving their 6 pectoral legs forward and bring up

the 4 anal or posterior legs with a jerk, forming by this action a loop or bend with their bodies. From this they are commonly called loopers. In the course of time, generally in the early part of June, when they attain the allotted term of caterpillar existence, or when food fails or becomes unsuitable, they let themselves down to the ground by means of ropes of silk and bury themselves under the surface in order to change into chrysalids. This change is speedily accomplished and they remain enwrapt in loose cocoons of silk until late in October or the commencement of November, at which time the moths appear. These have been seen as late as the end of December after an unusually mild season. It is after a mild early winter that the attacks of this moth may be dreaded. Cold weather and sharp frost in November kill many of the moths, and prevent them from depositing eggs.

Prevention. Where fruit trees are set upon grass-land the grass should be kept very short all round the trees, and indeed all over the orchard. Though the females are not able to fly, they can crawl and can well travel from tree to tree. After an attack it is certain that, as the caterpillars cannot crawl easily from their conformation, after they have let themselves down from their birthplaces, the greater part of the chrysalids will be under the surface of the soil, within easy distance of the trees from which they came. Therefore it would be very desirable to put round the trees strong liquid manure or strong guano water or ammoniacal liquor, or even quantities of water, or water mixed with a considerable quantity of paraffin oil—2 or even 3 wineglasses of oil to a pail of water.

Upon cultivated land gas-lime or lime, quick and fresh, should be put on a considerable area around each tree, and dug into the ground in the early autumn after an attack.

As the females must ascend the trees to lay eggs by crawling up their stems, it is advisable after an attack, or when many of the moths have been noticed in November evenings flying round the trees, to put noxious substances upon the stems to prevent their progress. A mixture of Stockholm tar and cart-grease in equal proportions may be used for this. It should not be put on earlier than October, as the sun melts the tar and it is absorbed into the tree with injurious effect. A piece of sacking well soaked in tar will also hinder their ascent. In both these cases the composition must be renewed from time to time.

Fruit growers in America and Canada fasten ingenious traps round fruit trees to circumvent the canker-worm, made of bands of stout linen, which are tied close round the stems. At the bottom of each linen band a strip of tin is fixed, with a rim turned up on its inner side, so as to prevent the moth from getting round. This, it may be observed, would serve equally well to keep back the caterpillars of the *Carpocapsa pomonella.*

In Germany wooden 'boots,' kept frequently tarred, are put round the stems of fruit trees to hinder the female moths from going up.

As these moths not unfrequently cause serious injury to filbert and cob-nut trees, and to gooseberry and currant bushes, it is most essential that all cuttings after winter pruning should be carefully removed. This is especially necessary in the case of filbert and cob-nut trees, from which so much wood is taken, and the growers should insist upon the cuttings being taken away by the cutters, whose perquisite they are, long before April. The same remarks apply to the branches and suckers pruned from apple trees, and indeed all fruit trees. It constantly happens that bundles of cuttings from fruit trees are left either in the plantations or close to their outsides, so that the neighbouring trees, and especially the low bushes, are often infested from them.

Remedies. When the caterpillars have gained a settlement upon apple trees in orchards and plantations very little can be done to dislodge them and to stay their progress. Wholesale and persistent syringing with soft soap and quassia and water, or paraffin and water, where this could be well done, would doubtless check the caterpillars, though it would be difficult to carry out this operation upon the ordinary trees in the typical orchards of the country, whose branches are thickly interlaced. Nor would it be possible to send up the water to the tops of the largest apple trees by means of the ordinary garden engines, or hop-washing engines, with any efficacious force, though it would not be difficult to obtain engines with pumps of greater power for the purpose.

Upon smaller apple trees and those kept well pruned, and upon pear, plum, and damson trees, syringing with the common hop-washing machines sold by most implement manufacturers could be advantageously adopted.

With respect to filbert and cob-nut trees and gooseberry and currant bushes, hand syringes, or syringes, fixed in pails, might well be used; or fruit bushes might be watered by means of ordinary water-pots with fine sprays.

Birds of many species are very fond of the caterpillars of the winter-moth. The titmouse clears them off fast, and the starling is eminently useful in devouring this and many other caterpillars injurious to fruit trees. As I have observed in another monograph, the starling makes its nest in orchards, if it can find a suitable hole. Wooden boxes are fastened high up in the apple trees in some orchards in Germany, to induce starlings to make nesting places therein. The chaffinch also loves to build its elaborate nest in an apple tree, instinctively knowing that it is a happy hunting ground when the young birds are clamouring for food. One or two species of linnets make fruit trees their breeding places, and it need hardly be said that such birds should be encouraged ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CHEKEN. The leaves of *Myrtus cheken* yield on distillation about 1% of an aromatic essential oil. The leaves also yield to alcohol a body called *chekenon* and *chekeine acid.* A fluid extract of the leaves is used as an aromatic expectorant in chronic coughs and bronchitis.—*Dose*, $\frac{1}{2}$ to 2 dr.

CHELSEA PENSIONER. *Prep.* From gum guiacum, $\frac{1}{4}$ oz.; rhubarb, $\frac{1}{2}$ oz.; cream of tartar, 2 oz.; flowers of sulphur, 4 oz.; nutmegs, 2 in number (all in powder); honey, $1\frac{1}{2}$ lb., or q. s.;

made into an electuary by beating them together in a mortar.—*Dose,* 1 to 2 tablespoonfuls, night and morning, in gout and chronic rheumatism. The name is said to have been given to it from the circumstance of a Chelsea pensioner having cured Lord Amherst with it.

CHEL'TENHAM SALTS. See SALTS.

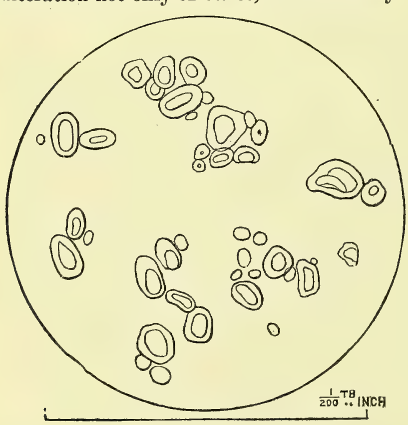
CHEM'IQUE or **CHEM'IC BLUE.** See INDIGO.

CHEROOT. A species of cigar imported from Manilla, in the Philippine Islands, distinguished by simplicity of construction as well as delicacy of flavour. The cigars now so commonly sold as cheroots in England are, for the most part, made of inferior tobacco, and are often much adulterated articles.

CHER'RIES are the fruit of different species of the genus *Cerasus.* They are regarded as wholesome, cooling, nutritive, laxative, and antiscorbutic. Brandy flavoured with this fruit or its juice is known as cherry-brandy. Morello cherries preserved in brandy are called brandy cherries. See BRANDY, FRUIT, &c.

CHER'RY LAUR'EL. *Syn.* LAU'REL. The *Cerasus lauro-cerasus,* a shrub common in every garden in England, and often confounded with the true laurel or Sweet Bay, which does not possess any of its deleterious properties. Leaves, occasionally used instead of bay leaves in cookery. The distilled oil and distilled water are both poisonous. See OIL, WATER.

CHESTNUT. The Horse-Chestnut (*Æsculus hippocastanum,* L.). A Turkish tree, long planted, for shade and ornament, on the Continent and in England. The wood, which is soft, and not durable, is turned to little account. The fruits are used in Switzerland and Turkey for feeding sheep, horses, &c. Both the horse-chestnut and the edible variety have been employed for the adulteration not only of coffee, but of chicory.



Microscopic view of the chestnut.

CHI'CA. The red colouring matter deposited by a decoction of the leaves of *Bignonia chica* in cooling. Used by the American Indians to stain their skin. It is soluble in alcohol, ether, oil, fat, and alkaline lyes, and slightly so in boiling water.

Chi'ca. See MAIZE BEER.

CHI'CORY. *Syn.* WILD SUC'CORY; CICHOR'IUM INTYBUS, Linn., L. A plant belonging to the Nat. Ord. COMPOSITÆ. It is indigenous to this and many other countries of Europe, and is extensively cultivated for the sake of its roots, which are sliced, roasted, and ground, to form the chicory of the shops. Nearly 100 millions of pounds are annually consumed in Europe. Much of the chicory used in Britain is of home growth; but still more is imported in a raw state from Holland and other parts of the Continent. A blue dye has been prepared from the leaves of this plant.

The FRESH ROOT OF CHICORY (*ra'dix chico'rii re'cens*) is reputed to be alterative, attenuant, diuretic, febrifuge, hepatic, resolvent, and tonic; and in large doses aperient. It is now seldom used in medicine, although it appears to possess qualities and equal activity to those of dandelion. "An infusion of the root, mixed with syrup, becomes thick; forming the GOMME SACCHO-CHICORINE of Lacarterie" (*Fee*).

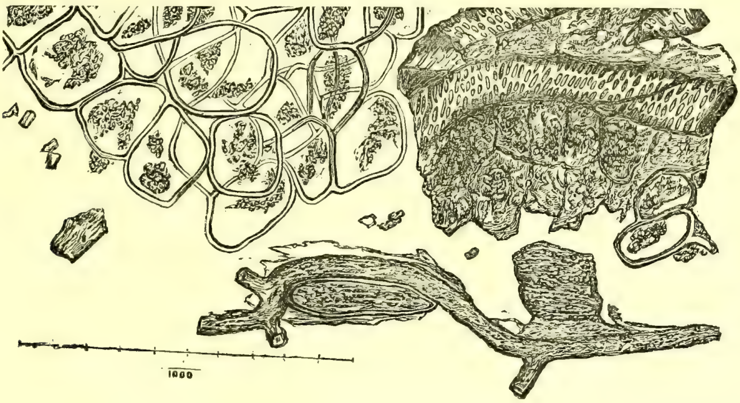
Analysis of Chicory (*the raw root*):

Moisture	77·0
Gummy matter (like pectin)	7·5
Glucose or grape-sugar	1·1
Bitter extractive	4·0
Fatty matter	0·6
Cellulose, inulin, and woody matter	9·0
Ash	0·8
	100·0

The ROASTED ROOT is prepared by cutting the full-grown root into slices, and exposing it to heat in iron cylinders, along with about $1\frac{1}{2}\%$ or 2% of lard in a similar way to that adopted for coffee. When ground to powder in a mill, it constitutes the CHICORY of the grocers (CHICORY COFFEE, SUCCORY C.; RADIX CHICO'RII TORREFACTA, R. C. T. CONTRI'TA); so generally employed both as a substitute for coffee and as an adulterant of that article. The addition of 1 part of good, fresh roasted chicory to 10 or 12 parts of coffee forms a mixture which yields a beverage of a fuller flavour and of a deeper colour than that furnished by an equal quantity of pure or unmixed coffee. In this way a less quantity of coffee may be used, but it should be remembered that the article substituted for it does not possess in any degree the peculiar exciting, soothing, and hunger-staying properties of that valuable product. The use, however, of a larger proportion of chicory than that just named imparts to the beverage an insipid flavour, intermediate between that of treacle and liquorice; whilst the continual use of roasted chicory, or highly chicorised coffee seldom fails to weaken the powers of digestion and derange the bowels. "There can be no doubt that roasted chicory must, when taken largely, have a tendency to excite diarrhœa" (*Pereira*).

Pur., &c. The ground chicory of the shops, like ground coffee, is almost universally adulterated. Pigments are added to it to colour it, and various vegetable substances to lessen its value. The following articles have been reported to have been detected in roasted chicory, or to have been known to be used to adulterate it:—Venetian red, reddle, and red clay; roasted acorn, beans, carrots, damaged dog-biscuits, damaged bread, damaged wheat, horse-

chestnuts, mangel-wurzel, parsnips, peas, rye, and sugar; coffee flights (coffee husks), coffina (roasted lupins), Hambro' powder (roasted peas coloured with reddle), and the marc of coffee; exhausted bark (from the tan-yards), logwood dust, mahogany dust, &c. It has also been asserted that the scorched livers of bullocks, horses, and dogs have been applied to the same purpose; but of this there is not sufficient evidence. The only way to avoid being thus cheated or poisoned is to buy the chicory whole and to grind it at home.



Microscopic appearance of chicory root.

Roasted chicory is highly absorbent of moisture, and should, therefore, be always kept in close vessels (bottles or canisters), the same as coffee. If the lumps become tough or soft, or the powder cakes together, it is unfit for use; but in some cases it may be recovered by exposing it on a plate in an oven until it again becomes perfectly dry or brittle.

Tests. 1. Powdered chicory thrown on water turns it reddish-brown and rapidly sinks, leaving light impurities either floating or diffused through the liquid. 2. The cold decoction tested with tincture, or solution of iodine, gives a brown colour; if it turns purple, blue, or black, it indicates the presence of roasted peas, beans, rye, or some other like substance, containing starch. 3. Persulphate or perchloride of iron, added in the same way, should not materially affect the liquid; if it turns it bluish or blackish it indicates the presence of roasted acorns, oak-bark tan, or some other substance containing tannin. 4. Water acidulated with vinegar, digested on the powder, should not be blackened, or even materially darkened, by tincture of galls or a solution of red prussiate of potash; the contrary shows the presence of ferruginous colouring matter. 5. The dry powder, when incinerated, should not leave more than $4\frac{1}{2}\%$ to 5% of ash, which should be of a greyish or fawn colour; the contrary indicates the presence of reddle, red clay, ochre, or the like. 6. To the above may be added attention to the odour, colour, and appearance, both to the naked eye and under the microscope; by the latter, adulteration may be easily detected. See Coffee.

CHIL'BLAIN. *Syn.* Per'nio, L.; Engelure, Fr.; Frostbeule, Ger. An inflammatory swelling of a purple or lead colour, produced by the action of cold. Chilblains (pernio'nes) exclusively attack the extremities of the body, and are generally confined to the fingers, toes, and heels. The common symptoms are itching and irritation, more or less intense, often accompanied with shooting pains, and tenderness, and tumefaction of the parts. Children, especially those of a scrofulous habit, and elderly persons, are generally the most liable to chilblains. The common cause of chilblains is holding the hands or feet to the fire after exposure to cold. The sudden change of temperature partially destroys the vitality of the minute superficial vessels, and thus prevents the proper flow of blood through the part. The best preventives of chilblains are woollen socks or stockings, good waterproof shoes, woollen gloves, exercise, and friction. These act by promoting the circulation of the blood in the extremities, and protecting them from vicissitudes of temperature. When chilblains have once formed, the best treatment is friction with stimulants, as spirits of wine and camphor, oil of turpentine, opodeldoc, dilute spirits, camphorated oil, hartshorn and oil, &c. Linnæus recommends bathing the part with dilute muriatic acid, just strong enough to faintly prick the skin. When the inflamed parts have ulcerated, they are commonly called kibes. In this state they should be dressed with a little resin cerate or elemi ointment. If fungous granulations appear, they must be removed by touching them with nitrate of silver or blue vitriol. See Chaps, &c.

Remedies for Chilblains. The following have been strongly recommended by different persons, and may all prove useful in their turns, as circumstances and convenience may suggest:

1. Sulphate of copper, 1 oz.; rosemary water, 1 pint; dissolve.

2. Sal-ammoniac, 1 oz.; vinegar, $\frac{1}{2}$ pint.

3. Sal-ammoniac, 1 oz.; rum, $\frac{1}{2}$ pint; camphor, 1 dr. The affected part is wetted with the above night and morning, and when dry is touched with a little simple ointment, cold cream, or pomatum.

4. Soap liniment, 2 oz.; tincture of cantharides, 1 oz.; oil of cajeput, 2 dr.

5. Oil of turpentine, 2 oz.; camphor, 3 dr.; oil

of cajeput, 1 dr. The application of the last two is accompanied by gentle friction.

6. (Dr Graves' Preventive.) Sulphate of copper, 20 gr.; water, 1 oz. As the first three.

7. (Lejeune's Balsam.) See Chilbain Balsam.

8. (Linnæus' Remedy.) Hydrochloric acid, 1 oz.; water, 11 oz. As No. 3.

9. (Morton's Liniment.) Calomel and camphor, of each, 1 dr.; spermaceti ointment, 4 dr.; oil of turpentine and cocoa-nut oil, of each, 2 dr. As No. 5.

10. (Wahler's Ointment.) Black oxide of iron, bole, and oil of turpentine, of each, 1 dr.; resin cerate, 1 oz. For broken chilblains. We have found a mixture of equal parts of calamine cerate and resin cerate answer quite as well. See Cerate, Ointment.

11. (Russian Remedy.) The rind of perfectly ripe cucumbers dried, with the soft parts attached. For use they are placed with the inner side, previously soaked in warm water, over the soft parts ('Med. Zeitung').

12. (Rhein.) Dissolve 1 *oz.* of tannin in a pint of water, and 74 gr. of iodine in $1\frac{3}{4}$ *oz.* of spirit of wine; the solutions are then mixed, and enough water added to make the whole up to $2\frac{1}{2}$ pints. In applying it, which is best done at bedtime, the mixture is gently warmed over a slow fire; the affected part is dipped into it while still cold, and retained in it till the liquid, on being stirred, feels uncomfortably hot. The vessel is then withdrawn from the fire, and the affected part dried over it. The vessel must be of earthenware or porcelain, and care must be taken not to use too much iodine, especially when abrasions are present.

13. (L'Union Médicale.) Oxide of zinc, 2 parts; tannic acid, 1 part; glycerin, 10 parts; balsam of Peru, 8 parts; camphor, 4 parts.

14. (Swediaur's Paste.) Bitter almonds, 8 oz.; honey, 6 oz.; powdered camphor and flour of mustard, of each, $\frac{1}{2}$ oz.; burnt alum and olibanum, of each, $\frac{1}{2}$ oz.; yelks of 3 eggs; beat to a paste. To be applied night and morning.

15. (Vance's Cream.) Ointment of nitrate of mercury, 1 oz.; camphor, 1 dr.; oil of turpentine, 2 dr.; oil of olives, 4 dr.; mix well together. To be applied by gentle friction 2 or 3 times daily.

Obs. All the preceding preparations are intended for chilblains before they break. The liniments of ammonia, camphor, opium, soap, and turpentine, as well as the compound camphor liniment of the British Pharmacopœia, are also excellent preparations for the same purposes.

The following are some notes from the 'British Medical Journal':

"No plan of treatment of chilblains will be universally successful, seeing that the conditions on which they depend are multiple. As dampness of feet in cold weather is an exciting cause, one very important point is to be extravagant in hose. The socks or stockings should be made of some woollen material, and it is better not to have them very thick. They must always be thoroughly dry when put on, and they should be changed as soon as they become damp, either from perspiration or from moisture coming through the boots. For this reason the socks should be changed immediately after taking exercise, and the same boots should not be put on again unless they are quite dry. The same pair of socks should not be worn for two consecutive days, but each pair should be washed, or at least thoroughly dried, before being worn a second time. On no account are the socks to be allowed to dry on the feet, and the practice of putting the feet before the fire is to be condemned. Chilblains are most prevalent when the weather is both cold and damp. It is in just such weather that many people eat more food and take less exercise than usual, thereby inducing indigestion, congestion of the portal system, constipation, &c., which in their turn lead to the development of chilblains. It is important, therefore, to insist upon regular exercise and a moderate diet, and to sedulously prevent constipation. For the immediate relief of itching nothing is better than soaking in hot water. Iodine is the best external application. It should be applied—either as ointment or tincture of twice the ordinary strength —once or twice a day so long as the skin remains swollen and red.

Dr Robert M'Bride thinks the following is most efficacious:—Lin. belladonnæ, 2 dr.; lin. aconiti, 1 dr.; acidi carbolici, 6 minims; collod. flexil., 1 oz.; mix. To be applied with a camel-hair pencil every night to the parts affected.

In addition to the above, the general health has to be looked after; tonics when they are required; but when the patient is perfectly healthy nothing else need be done. It is often advisable to keep the parts warm.

Dr G. E. J. Greene has found the following topical application a useful one, even when the chilblains are broken:—Flex. collod., 4 dr.; olei ricini, 4 dr.; spt. tereb., 4 dr.; mix. To be used twice or thrice daily.

As *erythema pernio* usually results from sluggish circulation with relaxed capillaries (external surroundings being favourable), a mixture containing tr. digit. and liq. strych. would probably be indicated. In addition Dr. Greene recommends, by way of prophylaxis, warm gloves and stockings, with the avoidance of artificial heat when the extremities are very cold, circulation being stimulated by exercise and *effleurage.*

Dr B. Nicholson writes: "It is some few years since I wrote the following, and all who have tried it have professed themselves satisfied with the results:—Spirit. camph., 2 dr.; tinct. opii, 2 dr.; acid. carbol., 40 gr.; spirit. vini, 4 dr.; aquæ, 4 dr.; M. et S.

If the skin be broken it may be useful to weaken the lotion with a little water, and to apply it on lint or with a soft rag.

Dr E. Head Moore, Falmouth, has for some winters past used only 'anodyne colloid' for this troublesome complaint, and invariably with success. It should be applied freely on the first sign of swelling or irritation.

CHIL'DREN (Care of). See Infancy.

Children (Diseases of). See the respective heads, and Diseases.

CHIL'LIES. See Capsicum, Peppers.

CHIM'NEYS were not introduced into England until the reign of Queen Elizabeth, and for a considerable period the principles of their construc-

tion were ill-understood. When the air inside and outside a chimney is at the same temperature, an equilibrium exists; there is no draught in the chimney, because the downward tendency of that within is counteracted by the upward pressure of that without. Let a fire be kindled in the grate; hot air is evolved, the chimney is heated, the air it contains suffers expansion, and a portion is expelled. The chimney now contains a smaller weight of air than it did before; the external and internal columns no longer equibalance each other, the warmer and lighter air is forced upwards from below, and its place is occupied by cold, and consequently heavier air. If the fire continues to burn, and the chimney retains its temperature, the second portion of air is disposed of like the first, and the ascending current continues, so long as the sides of the chimney are hotter than the surrounding air. Should the reverse happen to be the case, as sometimes occurs from sudden atmospheric changes, the column of air within the chimney rapidly contracts in volume, the deficiency is filled up from without, the column of air becomes heavier than one of a corresponding height on the outside of it, or in the apartment, and, obeying the common laws of gravitation, it falls out of the throat of the chimney or fire-place just as a heavy body sinks in water, and has its place occupied by air from above. In this way a descending current, of more or less intensity and duration, is established, and, if there is a fire in the grate, the chimney 'smokes,' or, if the grate be empty, perhaps the smoke from neighbouring chimneys finds its way into our apartments. By the judicious arrangement of the fire-place, and the throat and flue of a chimney, an upward current may be constantly ensured so long as there is a fire in the grate, or the air of the apartment is warmer than the external atmosphere.

Count Rumford was the first who scientifically investigated the construction of chimneys. He showed that more heat is obtained from the fire by reflection when the coverings are placed in an oblique position. He also directed that the fire itself should be kept as near the hearth as possible, and that the throat of the chimney should be constructed much narrower than was the practice, in order to prevent the escape of so much heated air as happened with wide throats. By contracting the open part of the fire-place immediately over the fire, as by lessening the width of the hobs, or by bringing the throat of the chimney closer to the fire, and by contracting the throat of the chimney itself, within certain limits, any desired amount of draught may be obtained. When the space above the fuel is too small, the throat too near the burning fuel, or the throat itself too contracted, the draught of a common chimney is often too strong, and much fuel and heat is wasted. When the reverse is the case, the draught is commonly too languid, the fire draws badly, a portion of the smoke escapes into the room, and all the usual annoyances of a smoky chimney are suffered. By a proper attention to these conditions a common fire-place may be adapted for the combustion of bituminous or easy-burning coal, or of anthracite, and varieties of coal that require a considerable draught. It may even be converted into a wind furnace; whilst the inconvenience of smoky chimneys may always be avoided, and, when existing, easily cured. This is presuming, however, that a sufficient supply of air exists in front of the fire-place (*i. e.* in the apartment), not only for the combustion of the fuel, but also for the upward current of the chimney. Many chimneys smoke simply from the apartment being so ill ventilated that the supply here alluded to is not provided. It may be further stated, as a rule, that the greater the length of a chimney the stronger will be the draught. Hence, the chimneys of the upper rooms of a house often smoke, whilst the fires in the rooms beneath them burn pleasantly and vigorously. Such cases are commonly relieved by a chimney-pot or cowl, of which numerous varieties are now before the public. The more crooked or tortuous the course of a chimney the less likely is it to be affected by eddies and gusts of wind from neighbouring buildings or hills. See FIRE, GRATE, SMOKE PREVENTION, STOVE.

CHI'NA. In the purchase of china, glass, and earthenware, care should be taken to select those patterns which in case of breakage can be the most readily matched. Peculiar or rare patterns should be avoided, for if any such be broken, it will generally be found very difficult and expensive, and frequently impossible, to replace them.

China, glass, and earthenware, when very dirty, are best cleaned with finely powdered fuller's earth and warm water, followed by rinsing in clean water. A little clean soft soap may be added to the water instead of fuller's earth. See PACKING, PORCELAIN.

CHINA-GRASS (*Bœhmeria nivea*, H. and A.), a nettle of China, India, and the Indian islands, affording the valuable RHEA fibre.

CHIN'OIDINE. See QUINOIDINE.

CHINOLINE BLUE. See CYANINE.

CHINTZ (to Wash). Boil 2 lbs. of rice in 2 galls. of water till soft; and pour the mixture into a tub; let it stand until it attains a warmth generally used for coloured linens; then put the chintz in it, and wash it with the rice instead of soap, until all the dirt has disappeared. Next boil another 2 lbs. of rice, as above, in another 2 galls. of water, but strain the rice from the water, and mix it in warm water. Wash the chintz in this till quite clean, and afterwards rinse it in the water the rice was boiled in. This will answer the same end as starch, as no wet will affect it, as it will be stiff while it is worn. If a gown, it must be taken to pieces; and when dried, it must be hung as smooth as possible, after which it must be dry-rubbed with a smooth stone, but no iron should be used.

CHIRETTA. CHIRATA. The entire plant (*Ophelia chirata*) is employed in medicine. Northern India. The plant is pulled up by the root when the flowers begin to decay, and the capsules are formed. The dried plant, sometimes with, but more commonly without, the root, is the form in which the chiretta is generally met with in commerce. The whole plant is intensely bitter, but is without odour. In its physiological action it bears a great resemblance to gentian. Instead of a constipating, it appears to possess a slightly relaxing effect. It is an excellent stomachic and

carminative, and is said to diminish the tendency to acidity, and to be of great service in the dyspepsia accompanying gout. No vegetable alkaloid has been obtained from it. If given in powder, the dose of chiretta is 20 gr. It is, however, more generally given in the form of an infusion or tincture (which *see*).

CHI'TIN. This name has been given to the hard, insoluble matter forming the shells and elytra of insects. It is obtained by boiling the elytra of the cockchafer with water, alcohol, ether, acetic acid, and alkalies.

CHIT'TICK'S REMEDY. Dr Chittick's remedy for stone consisted of a fixed alkali, administered in veal broth (Paris).

CHLORAL. C_2HCl_3O. A peculiar liquid first obtained by Liebig, by the action of chlorine on alcohol. The name was intended to express its origin from chlorine and alcohol.

Prep. (*Liebig.*) Anhydrous alcohol is placed in a tubulated retort, and dry chlorine gas passed through it, at first in the cold, but afterwards with the application of a gentle heat, until the chlorine passes unchanged through the liquor on raising it to the boiling temperature; on cooling, the whole forms a crystalline mass of what was at one time thought to be chloral hydrate, but which subsequent researches have shown to be chloral alcoholate; this is melted by a gentle heat, and agitated with 3 times its volume of oil of vitriol; on increasing the heat a little, an oily stratum of impure chloral rises to the surface. It is purified by boiling it for some time (to drive off free hydrochloric acid and alcohol), next distilling it with an equal volume of oil of vitriol; and lastly, rectifying it from some powdered quicklime, the process being stopped as soon as the surface of the lime becomes dry.

Prop., &c. Chloral is an oily liquid possessing an ethereal smell; it is soluble in alcohol, ether, and water; with a small quantity of the latter it rapidly changes into a semi-solid crystalline mass (chloral hydrate), which is soluble in a larger quantity of water; boils at 201° F.; sp. gr. 1·502. It is decomposed by the caustic earths and alkalies. By age it is converted into a white, solid, translucent substance (insoluble choral), which is reconverted by heat and by sulphuric acid into ordinary chloral.

Obs. In operating as above the chlorine is most conveniently introduced by a tube inserted into the tubulature of the retort, and a long tube, bent upwards, should be connected with the beak to convey away the hydrochloric acid gas extricated, and to allow the volatilised alcohol and chloral to condense, and flow back into the retort.

Chloral, Camphorated. Hydrate of chloral and camphor, equal parts. Rub them together in a warm mortar until they liquefy. It forms clear mixtures with oil of turpentine and chloroform, but not with solution of ammonia. It is a counter-irritant, and applied externally it has been found to give relief in rheumatic pains and neuralgia. It should be painted on the affected part with a camel-hair brush.

Chloral Hydrate. $C_2HCl_3O\ H_2O$. *Syn.* HYDRATE OF CHLORAL. *Prep.* "Pass dry chlorine gas, for several days, through absolute alcohol, sp. gr. 0·795, until it becomes a thick viscid liquid of sp. gr. 1·57. At the beginning of the operation the alcohol is well cooled to prevent inflammation and explosion, but towards the end of the operation the alcohol is heated nearly to the boiling-point. The resulting liquid, which after a day or two solidifies to a mass of crude chloral hydrate, is agitated with 4 times its bulk of concentrated sulphuric acid, and the anhydrous chloral which floats on the surface is separated and purified by fractional distillation. The purified anhydrous chloral is placed in a still, mixed with 11% of water, and distilled over chalk to remove any hydrochloric acid that may be present; the resulting solid distillate is then fused and poured out into shallow vessels to cast into cakes" (*Squire*). The purest chloral hydrate is said to be that which has been crystallised 2 or 3 times out of pure bisulphide of carbon.

Prop. White opaque solid, having a pungent odour resembling that of a ripe melon, or in colourless crystals which do not deliquesce on exposure to air. Heated gently it fuses and begins to solidify on cooling at about 48° C. Soluble in less than its own weight of water, rectified spirit, or ether, and in 4 times its weight of chloroform. Mixed with camphor, thymol, or menthol it forms fluids. 100 gr. dissolved in an ounce of distilled water and mixed with 30 gr. of slaked lime when carefully distilled should yield not less than 70 gr. of chloroform.

Chloral hydrate may be obtained in crystals by mixing the cake with about half its bulk of chloroform, and putting aside in a cool place. When the crystallisation is complete (which is generally in about 8 or 10 days) the crystals are freed from the mother-liquor by a centrifugal machine, and afterwards dried at a gentle heat. The mother-liquor may be utilised for future crystallisations.

Uses. An excellent sedative, antispasmodic, hypnotic, anodyne. It has done good service in hypochondriacal and other nervous affections, as well as in the insomnia of the insane, and of dipsomaniacs; also in asthma, whooping-cough, and scarlet fever; also used as an antidote against strychnia poisoning. It has also the reputation of being an efficient preventive of sea-sickness, especially on short voyages, such as crossing the Channel, which can be accomplished during the sleep occasioned by the agent.—*Dose*, from 10 to 60 gr.

It was introduced into medical practice by Dr Liebreich, of Berlin. Immense quantities are imported into this country from Germany.

CHLORALUM. An impure aqueous solution of chloride of aluminium, sp. gr. 1·15. 1 fl. oz. of the liquid contains 75 gr. of anhydrous chloride. Introduced by Professor Gamgee as an antiseptic and disinfectant, for which purposes it is recommended to dilute the article as sold with four times its bulk of water.

CHLORATE. *Syn.* CHLORAS, L. A salt of chloric acid, $HClO_3$. *Prep.* The chlorates may all be made by neutralising chloric acid with an oxide, hydroxide or carbonate, filtering the solution, evaporating it and allowing it to crystallise. But alkaline chlorates are usually made by passing chlorine into a solution of the caustic alkali or the carbonate, boiling the liquid, concentrating it and

allowing it to crystallise. The chlorate crystallises out while the chloride, which is also formed, remains in solution. See also SODIUM, CHLORATE OF. The other chlorates are made from calcium chlorate by double decomposition.

Prop. The chlorates greatly resemble the nitrates; like the members of the latter group they are all soluble in water, and are all strong oxidising agents; indeed, when powdered and mixed with inflammable substances, such as sulphur, sugar, &c., they form mixtures which deflagrate with great violence.

Tests. (1) Chlorates deflagrate when placed on red-hot charcoal. (2) When treated with concentrated sulphuric acid they colour the acid a deep yellow, evolving a greenish-yellow gas with an unpleasant chlorinous odour. N.B. Take care not to apply heat, as this gas explodes at a very low temperature. (3) When heated in a test-tube they evolve oxygen gas, and if the residue, which contains a chloride, be dissolved in water, and the solution filtered and treated with silver nitrate solution, a white precipitate of silver chloride will be formed, insoluble in nitric acid, but soluble in ammonia. This distinguishes chlorates from nitrates; the latter also give off oxygen on heating, but the residue gives no precipitate with silver nitrate. Pure chlorates themselves give no precipitate with silver nitrate.

CHLORHY'DRIC ACID. See HYDROCHLORIC ACID.

CHLORIDE, *Syn.* CHLORIDUM, L. A compound of chlorine with a metal or with a basic radical; *e.g.* sodium chloride, NaCl; ethyl chloride, C_2H_5Cl. *Prep.* Anhydrous chlorides are prepared by passing a stream of chlorine over the heated metal. If not required anhydrous they may be obtained by dissolving the oxide, hydroxide, or carbonate of the metal in rather dilute hydrochloric acid, concentrating the solution and allowing it to crystallise. They may also be often made by dissolving the metal itself in hydrochloric acid; zinc, cadmium, iron, nickel, cobalt and tin dissolve readily, copper only in strong boiling acid, and silver, gold, and mercury not at all. Insoluble chlorides, as those of mercury and silver, may be obtained as precipitates by adding hydrochloric acid, or a solution of common salt, to a solution of a soluble salt of the metal.

Prop. Some are colourless, some coloured. Ferric chloride gives a yellow, cobalt chloride a pink, and nickel and chromium chlorides green solutions; the other common chlorides give colourless solutions. All the chlorides are soluble in water except silver chloride and mercurous chlorides; lead chloride is only slightly soluble. Many chlorides fuse when heated and volatilise unchanged, others are completely or partially decomposed at a red heat. With the exception of the alkaline chlorides and those of the alkaline-earth metals, they are all reduced to the metal when heated in a current of hydrogen.

Tests. 1. Solutions of chlorides, when acidulated with nitric acid, give with silver nitrate solution a white curdy precipitate insoluble in nitric acid, soluble in ammonia solution, and turning black on exposure to light. 2. When heated with peroxide of manganese and sulphuric acid they evolve chlorine; this may be recognised by its odour, smell, and bleaching properties. If an insoluble chloride has to be examined, it should be dissolved in nitric acid, or digested with caustic potash, and the filtered solution tested for a chloride (as *above*).

For detailed information as to the chlorides of particular elements, see under the respective elements.

CHLORIMETRY. The estimation of 'available chlorine' in commercial bleaching-powder ('chloride of lime'). The strength of bleaching-powder is expressed in England, Germany, Russia, and America, by degrees which indicate the weight of available chlorine contained in 100 parts by weight of the sample, in France by degrees which indicate the number of litres of chlorine gas that can be obtained from 1 kilo. of the sample. The French degrees can be converted into the corresponding English ones by multiplying them by the factor 0·3178. A comparison of the two scales is given below.

French Degrees.	Percentage of Chlorine.	French Degrees.	Percentage of Chlorine.
63	20·02	96	30·51
64	20·34	97	30·82
65	20·65	98	31·14
66	20·97	99	31·46
67	21·29	100	31·78
68	21·61	101	32·09
69	21·93	102	32·41
70	22·24	103	32·73
71	22·56	104	33·05
72	22·88	105	33·36
73	23·20	106	33·68
74	23·51	107	34·00
75	23·83	108	34·32
76	24·15	109	34·64
77	24·47	110	34·95
78	24·79	111	35·27
79	25·10	112	35·59
80	25·42	113	35·91
81	25·74	114	36·22
82	26·06	115	36·54
83	26·37	116	36·86
84	26·69	117	37·18
85	27·01	118	37·50
86	27·33	119	37·81
87	27·65	120	38·13
88	27·96	121	38·45
89	28·28	122	38·77
90	28·60	123	39·08
91	28·92	124	39·40
92	29·23	125	39·72
93	29·55	126	40·04
94	29·87	127	40·36
95	30·19	128	40·67

The chief chlorimetrical methods will now be shortly described. For fuller information consult Sutton's 'Volumetric Analysis,' 5th ed., p. 137, &c., or Fresenius' 'Quantitative Analysis,' 6th German ed., vol. 2, p. 318, &c.

The Bleaching-powder Solution. This is used in all the processes, and is best described before entering on these in detail. To make the solution, the sample of bleaching-powder is well and quickly mixed, 7·17 grms. of it are weighed and put into a mortar, a little water is added, and the mixture rubbed to a smooth cream. More water is then stirred in, the liquid is allowed to

settle for a little while, and then poured off into a litre flask. This is repeated till the whole of the bleaching-powder has been conveyed into the flask without loss, and the mortar washed quite clean. The flask is now filled up to the mark with water, and measured portions of its contents are taken out as required, care being taken that the flask is in each case well shaken before removing any of the liquid.

Penot's Method. A decinormal solution of sodium arsenite, and some prepared starch-papers are required. The sodium arsenite solution is made by dissolving 4·95 grms. of pure sublimed arsenious anhydride in powder in about 250 c.c. of distilled water, with about 20 grms. of the purest sodium bicarbonate; the liquid must be boiled and shaken in order to effect complete solution. The whole is then allowed to cool and diluted with distilled water to 1 litre. To make the starch-papers, 1 part of clean arrowroot or potato-starch is mixed smoothly with cold water into a thin paste, and then gradually poured into about 150 or 200 times its weight of boiling water, the boiling is continued for a minute, and the solution is then allowed to stand and settle. The clear liquor is decanted off, and forms the starch solution to be mentioned hereafter. To prepare the starch-papers a portion of this solution is mixed with a few drops of solution of potassium iodide, and strips of pure filtering-paper are dipped in it. These may be dried and preserved in a stoppered bottle, but they are much more sensitive when used moist.

For the actual estimation, 50 c.c. of the bleaching-powder solution are withdrawn by means of a pipette and placed in a beaker, and the sodium arsenite solution is run in from a burette till a drop of the mixture, taken out with a glass rod and brought in contact with the prepared starch paper, gives no blue stain.

The number of c.c. of the arsenite solution used gives the percentage of available chlorine in the sample examined. The method is easily carried out, and gives accurate results.

Mohr's Method. A modification of Penot's method. In addition to the above solutions a decinormal solution of iodine is required. This is made by dissolving 12·65 grms. of pure dry resublimed iodine in distilled water with about 18 grms. of pure white potassium iodide, and making up the solution to 1 litre with water.

50 c.c. of the bleaching-powder solution are run into a beaker as before, excess of the arsenite solution is then run in from a bruette, and the excess of the latter is estimated by adding a few drops of starch solution, and running in the iodine solution from a burette until a blue colour appears. If x c.c. of arsenite, and y c.c. of iodine solution have been used, then $(x-y)$ expresses the percentage of available chlorine in the sample examined. This method gives accurate results, but is not quite so simple as the equally accurate method of Penot.

Bunsen's Method. For this a decinormal solution of sodium thiosulphate is required; it is made by dissolving 24·8 grms. of pure dry sodium thiosulphate in water, and making up the solution to 1 litre. If impure or moist thiosulphate is used the solution must be adjusted so as to be equivalent to the iodine solution mentioned above. 10 c.c. of the bleaching-powder solution are measured into a beaker, and an excess of solution of potassium iodide is added; the solution is then diluted with water and acidified with hydrochloric acid, and the liberated iodine is estimated by running in the thiosulphate solution from a burette till the colour has nearly disappeared, then adding a few drops of the starch solution, and continuing the addition of thiosulphate till the blue colour disappears; the number of c.c. of thiosulphate solution used multiplied by 5 gives the percentage of chlorine in the sample examined. There is one defect in this method, it estimates the chlorine existing as a chlorate as well as that existing as a hypochlorite. Now the former is not available for bleaching purposes, and hence, from the manufacturers' point of view, this method gives too high results.

Otto's Method. Ferrous sulphate is prepared by dissolving clean iron nails in dilute sulphuric acid, warming towards the end, filtering the warm solution, and allowing it to fall into about twice its volume of alcohol. The precipitated ferrous sulphate is filtered and spread out on filter-paper to dry; and when it no longer smells of alcohol, it is placed in a well-stoppered bottle. Dissolve 3·927 grms. of this in water with a little sulphuric acid, and make the solution up to 250 c.c. Take 50 c.c. of this solution, put it in a beaker, and add hydrochloric acid. Now shake up the bleaching-powder solution, and pour some of it into a 50 c.c. burette, and run it out from this into the beaker until a drop of the solution in the latter, when removed with a glass rod and brought in contact with a drop of solution of potassium ferrocyanide placed on a white porcelain tile, give no blue colour. If x c.c. of the bleaching powder solution are used, then the percentage of available chlorine in the sample is give by the expression $\frac{1414}{x}$. Instead of ferrous sulphate an equivalent quantity (5·537 grms.) of ferrous-ammonium sulphate may be used. The method gives good results, provided that the ferrous sulphate is dry and free from ferric sulphate.

Lunge's Method. For this a Lunge's nitrometer is required. A solution is made of 10 grms. bleaching-powder in 250 c.c. of water; this is shaken up, and 5 c.c. of the turbid liquid are placed in the decomposing flask of the nitrometer, and an excess of hydrogen peroxide (about 2 c.c. of the commercial solution) is put into the inner tubes. The flask is now fitted by a piece of rubber tubing to the stopcock of the nitrometer, the tap is turned so that the flask communicates with the measuring tube, and the level of the mercury in the latter is read off, the mercury having been previously adjusted to the same level in both limbs of the apparatus. The flask is now inclined, so as to cause the two liquids contained in it to mix; oxygen gas is given off, the reaction being complete in 1 or 2 minutes. The mercury is again adjusted to the same level in both limbs, and its level in the measuring tube is again read.

Let x be the difference between these readings, the tube being graduated in cubic cm. The

barometric height (H) and the temperature (t°C) are also observed, the pressure of water vapour (h) at this temperature is found from tables, and is subtracted from the barometric height; this difference will then be $H-h$. The following expression gives the percentage of available chlorine in the sample examined: $0.57\ x\ \frac{H-h}{273+t}$.

Numerous other methods have been proposed for the estimation of chlorine in bleaching-powder, and many of them give good results. For further information respecting them, special treatises on the subject must be consulted.

CHLORINA'TED LIME. See LIME.

CHLORINA'TED SO'DA. See SODIUM.

CHLORINE. Cl=35·4. *Syn.* CHLORUM, L.; CHLORE, Fr.; CHLOR, Ger. A non-metallic element belonging to the same group as fluorine, bromine, and iodine, all of which elements it much resembles in chemical properties. It was once thought to be a compound of oxygen with muriatic (hydrochloric) acid, and was hence called oxymuriatic acid; but in 1810 Davy showed that it must be an element.

Source. It does not occur free in nature, but always in combination with metals, as chlorides. Of these sodium chloride is found, as *rock salt*, at Northwich in Cheshire, Carrickfergus in Ireland, Wielicksa in Galicia, Stassfurth in Prussia, and elsewhere. At Stassfurth large quantities of potassium and of magnesium chloride are also found. Sea-water contains chlorides of sodium, potassium, calcium, and magnesium.

Prep. Chlorine may be made on the small scale by heating hydrochloric acid, or salt and sulphuric acid, with peroxide of manganese. The action commences in the cold, but is accelerated by the application of a gentle heat. The gas is soluble in water, and attacks mercury, but it is about $2\frac{1}{2}$ times as heavy as air, and may therefore be collected by displacement. The gas, as it comes from the generating flask, should be passed through water to free it from hydrochloric acid gas, and then, if it is required to be dry, over fused calcium chloride, and finally led through a tube to the bottom of the jar in which it is to be collected. It gradually displaces and drives out the lighter air, and the jar may be seen to be full by the greenish-yellow colour, due to the chlorine gas, extending to the mouth of the jar. The gas may also be collected over a warm saturated solution of common salt, as it is much less soluble in this solution than in water.

On the large scale chlorine is manufactured, as a first stage in the manufacture of bleaching-powder, by one of the three following processes:—(1) The Weldon process; (2) the Deacon process; (3) the Weldon-Péchiney process. The numerous other processes which have been proposed are of scientific importance merely, and are not used to any extent on the large scale.

The Weldon Process. In this process chlorine is made from hydrochloric acid by heating it in stone stills with manganese peroxide by means of a current of steam; the reaction which takes place is represented by the following equation:

$$4HCl + MnO_2 = MnCl_2 + 2H_2O + Cl_2.$$

The hydrochloric acid is got from the soda manufacturer, by whom it is obtained as a by-product in the first stage of the Leblanc process for the manufacture of soda from sodium chloride. The important part of the Weldon process is the method by which the manganese is recovered from the 'still-liquor.' The stages of this process are described below:

1. The acid still-liquor is run into a *neutralising well*, which is a somewhat shallow vessel sunk in the ground, and built of large stone slabs in an octagonal form, or of fire-bricks or hewn free-stone in a circular form. As in all cases where stone vessels are used in the manufacture of chlorine, the stone must be acid-proof, and set in tar-pitch and sand in the most careful manner. In this well the still-liquor is neutralised by adding calcium carbonate, in the form of ground chalk, limestone, lime riddlings, &c., till all free acid has been neutralised, and all the iron present precipitated as hydroxide. The chalk, &c., should be finely ground, and as small an excess of it as possible should be used; while the chalk is being added the liquid is kept stirred by means of a mechanical agitator.

2. The neutralised liquor, along with the mud, is now pumped up into the *chloride-of-manganese settlers*. These are rectangular tanks constructed of cast-iron flanged plates bolted together. In these the manganese liquor is left to settle for some hours, and then the clear liquor is run off into the oxidiser. After a considerable quantity of mud has accumulated in the settlers, it is run off into another vessel, allowed to settle further, and the manganese liquor separated from it as far as possible by means of a filter-press.

3. In the *oxidisers*, which are cylindrical in shape and made of wrought iron, the clear manganese liquor is treated with milk of lime in excess, and then air is blown through the mixture. The lime precipitates the manganese as the hydroxide, and when air is blown through the mass, this is oxidised to the peroxide, and then forms, with the excess of lime present, compounds having the formulæ $CaO.2MnO_2$ and $CaO.MnO_2$, termed by Weldon 'calcium manganites.' The reason for adding excess of lime is that in the presence of free calcium hydroxide the manganese hydroxide is much more thoroughly oxidised by the current of air, and that in much less time than when no excess of lime is present. The milk of lime is made from very pure lime, especially free from magnesia; this is burnt down to a maximum of 2% of carbonic acid, but must not be overheated, as in that case it does not slake easily and completely. It is heated with water in iron cylinders fitted with mechanical agitators, and the resulting liquid, which should contain from 20 to $22\frac{1}{2}$ *lbs.* lime per cubic foot, is run through a finely perforated zinc plate, and then pumped up into a reservoir situated above the oxidiser. From this it is run into the oxidiser till a small sample of the liquid in the latter, when filtered from precipitated manganese, gives an alkaline reaction with litmus paper, indicating the presence of excess of lime, and gives no brown colour with strong bleach-liquor, indicating the absence of manganese in the solution. The amount of lime that has been added is now noted, and a quarter or a third of this quantity is then added

in excess. The blast is now put on with full strength as quickly as possible, and the *blowing* commenced; the colour of the thin mud, at first light yellow, changes to brown and finally to deep black. This operation generally lasts for 3 or 4 hours. A filtered sample of the liquid should give a perceptible alkaline reaction for at least an hour after the commencement of the blowing; it frequently does not cease at all to do this, showing that excess of lime has been added. The final stage of the operation is now commenced by adding some more manganese liquor—'final liquor' it is termed. The object of this is to act upon half the lime existing as $CaO.MnO_2$ forming from it $CaO.2MnO_2$ and precipitating more manganese protoxide, which is afterwards converted into a higher oxide. The final liquor is first added until the filtrate from a sample of the mixture gives the brown manganese reaction with bleach-liquor; this reaction ceases after a few minutes, all dissolved manganese having been precipitated. Then a little more final liquor is added, and the blowing continued till the filtrate from a further sample ceases to be coloured by bleach-liquor; this is repeated till it is seen, from the time which it takes to blow out the manganese, that the limit is reached. Now the blowing is continued a little longer, till the filtrate remains undoubtedly clear, when the bleach-liquor is added; and at last the whole contents of the oxidiser are discharged into one of the settlers. This final stage of the operation lasts about 1½ hours. If even the first final liquor cannot be easily 'blown out,' it is a sign that too little lime is present; if, on the other hand, very much final liquor is used, too much lime has been added, and in successive batches a smaller quantity must be added. The total quantity of MnO_2 per cubic foot is not always increased in the final stages; sometimes it is even lowered, but the proportion of base (MnO and CaO) to MnO_2 is always diminished.

In the oxidising process two faulty operations are liable to occur. A *red batch* is obtained if the air blast is working at full strength before any excess of lime has been added to the liquor. The mixture then turns brown-red instead of black, Mn_3O_4 being formed instead of MnO_2, and there is no way known of oxidising this Mn_3O_4, when it is once formed, to MnO_2. A *stiff batch* occurs under opposite conditions, *i.e.* when the blast is not strong enough. It is perceived by the engine beginning to labour heavily, and the pressure in the air-vessel rapidly rising; the engine at last stops entirely. This usually occurs at the commencement of an operation, when too large an excess of lime has been added. The only remedy is to put all available pressure on the blowing-engine, and run fresh manganese liquor into the oxidiser to dissolve the excess of lime, until the engine works quite freely again. The batch, however, does not generally come out good at the last.

4. The *manganese mud settlers,* into which the mixture from the oxidisers is run, are built just like the liquor settlers; they are rectangular vessels of cast-iron plate. In these the manganese mud is allowed to settle, and the supernatant calcium chloride solution is drawn off.

5. The recovered manganese mud is now treated with hydrochloric acid in the stills. The Weldon chlorine stills are of large size, sometimes as much as 12 feet in height. They are square or octagonal in shape, and are built of stone cemented with a mixture of tar and china-clay ('black stuff'). A steam-pipe, bored out of a square stone column, passes through the cover and rests in a socket in the base of the still; near its bottom it has several cross holes to allow of the escape of steam. The still has also a stoneware pipe near the top for running in the manganese mud, and lower down another pipe through which the hydrochloric acid is run in. The whole is fastened together with strong iron corner brackets furnished with screw bolts, and is further strengthened by bracing it with strong railway plates pressing against the stone, and bolted together at the corners. All the iron work is thickly coated with coal-tar pitch, and does not touch the stone directly, pieces of sheet lead being placed between. The operation in the still is performed as follows:

First, hydrochloric acid is run in to a depth of 2 feet—the hotter from the condensers the better, and then manganese mud is run in, but not so fast as to generate a very strong current of chlorine. The supply of the manganese mud is stopped as soon as the dark colour of a test sample of the liquid in the still shows that there is enough of it, and steam is then blown in, when the liquid again clears up if acid be present. The limit is reached when at a sufficient temperature the liquid is clear but coffee-coloured (a light yellow colour showing an excess of acid), and does not produce a *strong* effervescence when poured upon chalk. Or it is better to ascertain by titration with a standard soda solution that there is not more than ½% of free acid present. The saturation of the acid should not go too far, as then some manganese mud would remain behind undissolved, subside along with the neutralising mud, and be lost. When the proper point has been reached the contents of the still are run into the neutralising well and the whole cycle of operations commenced anew. Each operation in the still lasts from 4 to 6 hours.

Lunge ('Sulphuric Acid and Alkali, &c.') gives £2877 as the amount actually spent in 1873 upon erecting plant for Weldon's chlorine-process sufficient to turn out 6 or 7 tons of bleaching-powder daily. The circumstances were, however, somewhat unfavourable, as the prices of iron-work, labour, &c., were then very high, and all materials and labour had to be procured from the other end of England. The same authority also gives £6 5*s.* as the inclusive cost of 1 ton of 37% bleach at St Helens in 1874; the materials were then still very costly. The cost of recovering manganese at some large works in Widnes in 1870 is stated to be £1 per ton of 37% bleach, inclusive of interest, &c.

The Deacon Process. This consists essentially in passing a mixture of gaseous hydrochloric acid and air over heated bricks coated with copper sulphate or chloride. Under the influence of the latter substance the oxygen of the air combines with the hydrogen of the hydrochloric acid, forming water, and setting free chlorine; only a portion, however, of the hydrochloric acid is thus decomposed. The gaseous products are then

passed through condensers, where hydrochloric acid condenses, and are then dried and passed over slaked lime in order to form bleaching-powder. The actual working of the process is described below.

Each individual furnace consists of one pan and a furnace ('roaster'), in which salt is treated with sulphuric acid in the first stage of the Leblanc soda process. The whole of the pan-gas, comprising from 68% to 70% of the HCl of the salt, enters the Deacon apparatus, whilst the roaster-gas passes directly to a condensing tower. The pan-gas is cooled as much as possible by a long string of pipes and a scrubber; thus water, along with some condensed hydrochloric acid (about 1-6th or 1-5th of the pan-gas) is removed. The gases now enter the *heating apparatus*. This is a furnace 16 feet square in which 24 vertical pipes, 12 inches wide and 9 feet high, are arranged in 2 sets of 12 each, so connected that as little resistance as possible is offered to the gas passing through. Here the gas is heated to 400° C. (750° F.); the waste heat of this furnace is employed for heating the decomposer, which does not possess any fire of its own. The *decomposer* is an upright cast-iron cylinder, 12 to 15 feet wide. It contains a cylindrical ring of broken bricks supported by cast-iron shutters. The gases enter the annular space between the outside of this ring and the iron cylinder, they pass radially through the bricks into the cylindrical cavity in the centre of the latter, and are then led off. The annular mass of brick is 3 feet thick, and is divided into 6 compartments, 1 of which is emptied every fortnight, and filled again with the fresh material, which is made by dipping lumps of burnt clay into a solution of cupric chloride. During the passage of the gaseous mixture, if equal volumes of air and hydrochloric acid are present, at most 50% of the HCl is decomposed. From the decomposer the mixed gases are cooled by being led through a long series of stoneware or glass pipes, then the hydrochloric acid is entirely washed out by water, and the purified gases are now dried by passing them up a leaden tower packed with coke, down which strong sulphuric acid trickles. The chlorine gas thus obtained is so largely diluted with nitrogen and an excess of oxygen that its absorption in ordinary bleaching-powder chambers is not practicable. It is led over a series of trays so arranged in consecutive chambers that the gas passes at first ever lime that is already nearly saturated with chlorine, and then over lime containing less and less chlorine. As soon as the lime in the first chamber has been quite saturated with chlorine, it is removed and replaced by fresh lime, and the chamber is placed at the end of the series. Such an apparatus furnishes, from 45 tons of salt per week, 18 to 20 tons of bleaching-powder containing 35% to 36% available chlorine; moreover, all the roaster-gas and about 1-6th of the pan-gas are yielded up as strong acid even before passing through the decomposer; after that passage about half of the undecomposed hydrochloric acid is obtained in the strong state, the remainder having a strength of about 8% or 10%. By combination with a Weldon apparatus at least another 6 or 7 tons of bleaching-powder can be made from the condensed acid; so that the combined process yields 25 tons of bleach from 45 tons of salt.

The Deacon process has several drawbacks, and has not met with the same wide acceptance as the rival Weldon process. To begin with, the initial cost is very high, a plant such as that described above costing at least £8000, and in some cases double that sum. And the output is at most 18 to 20 tons per week, so that the interest and amortisation of the above capital forms a considerable item in the cost of the bleach. The repairs of so complicated an apparatus must also amount to a considerable figure.

The Weldon-Péchiney Process. This process was worked out, from a suggestion of Mr Weldon's, by MM. Péchiney and Boulouvard at the works of the former gentleman at Salindres in the South of France. Results of the working of a small experimental plant have been published, and an installation on a larger scale has been completed at Salindres, but of the working of the latter no data are at present available. M. Péchiney estimates the cost of 1 ton of chlorine by the Weldon-Péchiney process as £7 9*s.* as against £13 1*s.* by the old Weldon process, but the initial cost of the plant for the new process will be double that in the case of the old. A short sketch of the new process is given below:

1. Magnesia is dissolved in hydrochloric acid (part of which results from stage 5), the operation being stopped for a while whenever the solution nearly begins to boil. Some oxychloride of magnesium in powder, obtained in stage 3, is also dissolved; the operation is carried on in a well. Some magnesia is then added in slight excess to precipitate the foreign oxides present, and also some calcium chloride in order to precipitate any magnesium sulphate. The solution is pumped into standing vessels, where the insoluble matters are deposited, and:

2. The clarified solution is boiled down till it contains about 6 equivalents of water, and then about $1\frac{1}{3}$ equivalents of MgO are added for every equivalent of $MgCl_2$, in order to form the the oxychloride. The whole mass solidifies, and is obtained in the form of solid pieces of various sizes.

3. These are then crushed and sifted; the smaller parts cannot be treated in the decomposing furnace, because they would render the charge too compact, and therefore difficult to be traversed by gases; they are, however, used in stage 1.

4. The oxychloride is now dried by a current of hot gases. During this operation a large amount of water is given off, and a certain amount of hydrochloric acid.

5. The dried oxychloride is then heated in chambers to which air has access; it is converted into the oxide, magnesia, and the mixture of gases and vapours given off, which contain both chlorine and vapour of hydrochloric acid, is aspirated through (1) an ordinary HCl condensing tower, (2) a number of sandstone bonbonnes, (3) a glass tube refrigerator. The gas thus purified may be used to make bleaching-powder, &c. The magnesia taken out of the furnace is sifted from undecomposed oxychloride, which is used over again, while the magnesia itself is treated as in stage 1.

As regards the prevalence of the above three

methods, the last has only been used at Salindres, and it is impossible to say at present whether it is ever likely to become general. It probably will not do so in England; but at Stassfurth, where enormous quantities of magnesium chloride are thrown away yearly as valueless waste product, it might be adopted with great advantage.

In 1877 there were 50 Weldon plants at work in England, Scotland, and Ireland, turning out about 105,000 tons of bleaching powder, or its equivalent in chlorate of potash. This is about 90% of all that is manufactured in Great Britain. In France there were 8 plants turning out 20,000 tons of bleach and chlorate, being all that was made in that country; in Germany 7 or 8, Austria 2, Norway 1, Belgium 1. Except that in Germany there was 1 Deacon plant, all the bleaching powder made on the Continent was made by the Weldon process.

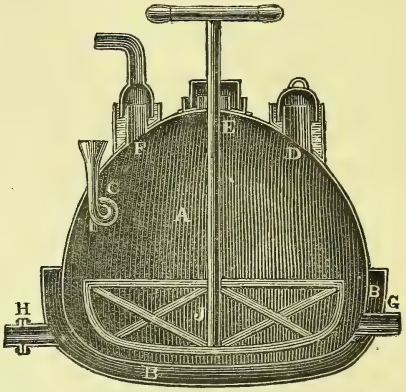
Prop., Uses, &c. Chlorine is a gas possessing a yellowish-green colour and a pungent suffocating odour. It is one of the heaviest gases, being $2\frac{1}{2}$ times as heavy as air. Water at the ordinary temperature dissolves nearly $2\frac{1}{2}$ times its volume of chlorine, and the solution has a greenish-yellow colour, and smells strongly of the gas. Chlorine may be liquefied by a pressure of 6 atmospheres at 0° C. (32° F.), or by cooling it to $-34°$ C. ($-29°$ F.) at the ordinary atmospheric pressure. It does not burn in air, but combines directly with nearly all the forming chlorides, often even at the ordinary temperature, *e.g.* powdered antimony takes fire when thrown into a jar filled with chlorine gas. When its solution in water is cooled to nearly 0° C. (32° F.) a solid crystalline hydrate is formed, having the formula $Cl_2 + 10H_2O$; this easily decomposes into an aqueous solution of chlorine and chlorine gas. In the presence of sunlight chlorine decomposes water, uniting with the hydrogen to form hydrochloric acid, and setting free the oxygen. It is to this property that chlorine owes its bleaching and disinfectant action, for the nascent oxygen resulting from the decomposition of the water attacks colouring matters and putrid organic substances, and deprives the former of their colour and the latter of their deleterious properties. Chlorine is, in fact, largely used as a bleaching agent and disinfectant; it was formerly used in the gaseous state, but it is now found more convenient to combine it with slaked lime, and use the 'chloride of lime' thus obtained in the actual process of bleaching. See Bleaching.

Tests. Chlorine may be recognised by its colour and odour, and by its bleaching properties; a piece of litmus-paper moistened with water and held in the gas is turned white. For methods of detecting chlorine when combined with another element, as in the chlorides, see Chloride *above*.

CHLORINE STILLS. The accompanying figure represents a section of one of the earlier forms of still used in the preparation of chlorine.

These stills were sometimes made of strong sheet lead, the lower part of which was enclosed in a jacket of cast iron, into which steam was forced, by which means the contents of the still were heated. The steam was injected from an ordinary boiler through the pipe, H, and the materials, after the decomposition had been completed, were drawn off by the pipe, G. The four openings, C, D, E, F, were secured by water lutes,

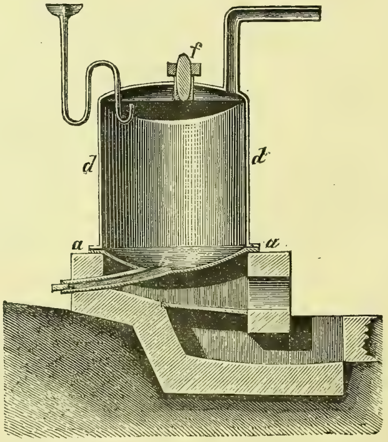
Fig. 1.



capable of bearing a pressure greater than that required in the chamber where the saturation took place. In some cases the lower half of the still was made of cast-iron, and fitted into a groove made in the upper part, the two sections being united by means of a strong cement. In the latter case the heating of the still was effected by a naked fire applied to the bottom. Into the orifice, C, the said materials employed were introduced, whilst the acid was poured through the opening, F. The gas evolved passed off through the pipe, E, to the purifier and chamber, where it was absorbed by the lime, and converted into bleaching-powder, and the shaft of the agitator passed up through D.

The use of the leaden stills survived for a longer time in France than in this country. In some parts of Germany large glass globes with long necks were employed, in which the chlorine was

Fig. 2.

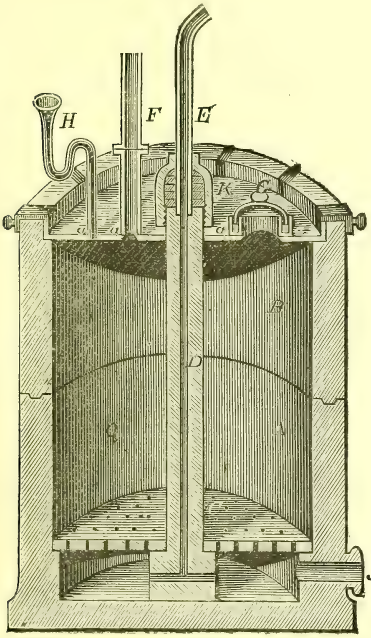


generated from a mixture of hydrochloric acid and manganese. But these were only applicable in cases where comparatively small quantities of

bleaching powder were to be manufactured. When the chlorine is obtained from a mixture of manganese, common salt, and sulphuric acid, the apparatus, being required to withstand a greater heat, is made entirely of metal.

In fig. 2, *a a* represents a shallow iron pan, fitted with the tube, *b*, for the purpose of emptying the contents of the leaden cylinder, *d d*. This iron vessel serves as the lower part of the cylinder, *d d*, the top of which is provided with an opening for a funnel syphon tube for the introduction of the acid, and another opening, *f*, for the manganese. The entire apparatus stands on a flue leading from the furnace.

Fig. 3.



The foregoing drawing represents a vessel for the manufacture of chlorine on a large scale, and is extensively used in Germany.

It consists of a cylindrical vessel of sandstone, the lower half of which, A, is carved out of a single block; the upper half, B, also of one piece, fits into the lower by means of a grooved joint, the two parts being united by means of a cement made of clay and boiled linseed oil. About 2 inches from the bottom the cylinder widens by 6 in., and the rim thus formed carries a perforated bottom, C, upon which the manganese is deposited in large lumps. The tube, D, likewise of stone, passes beneath the perforated bottom, and is at the other end joined to the steam-tube, E; the steam must, therefore, when introduced, enter the cylinder through the perforations of the false bottom. The top of the cylinder is closed by a lead cover, K, which is fastened down by means of iron clamps; this lid has an aperture, G, and the tubes, E, F, H, pass through it; tube E serves, as already stated, for the introduction of the steam; tube, F, is for the delivery of chlorine; the bent tube, H, which ends in a funnel, for the introduction of the hydrochloric acid; and the opening, G, for throwing the lumps of manganese into the cylinder. The solution of manganese chloride, resulting from the action of the hydrochloric acid upon the manganese, is removed through I, which is kept closed by a wooden stopper whilst the reaction proceeds.

The still which has been in use in England for the last 30 years, and which, ever since the introduction of Weldon's process, is still required for decomposing the fresh manganese that is needed to replace the small amount lost in the recovery process, is similar in principle to that figured above (fig. 3), but, instead of being cut out of a single cylindrical block of stone, it is rectangular in shape, and is built up of flags of siliceous sandstone obtained from Halifax, Felling-on-Tyne, &c. If the stone is at all porous it is first boiled in tar, and the joints of the flags are, in all cases, made tight by india-rubber cord; or feather-and-groove joints are employed, tar and fireclay cement being used. The flags are bound together by iron ties, and, in order to prevent it from settling down, the whole still must stand on a very substantial foundation; the foundation cannot be set with lime-mortar, but only with tar and sand. The still has a false bottom, or grate, formed of sandstone sleepers placed close together; this permits the employment of finely powdered manganese, and the rough sides of the sleepers do not touch closely enough to prevent the acid getting through. Through the lid of the still, and through the false bottom penetrates the steam-pipe, which is cut out of a column of sandstone, and has three horizontal openings beneath the grate to allow of the escape of steam; to its top part is attached a lead pipe, which is bent in a circular loop, and above the loop has a stopcock, so that when the steam is turned off water condenses in the lower bend of this loop, and prevents the chlorine from reaching and corroding the stopcock. The chlorine gas escapes through a tube attached to the lid of the still to one arm of a Y tube placed in a vessel of water, and having the lower end open, but dipping under the water; the gas passes off through the other arm to the gas main. By pouring more water into the vessel so that its level rises above the bend of the Y tube, the still is cut off from the gas main, and may be cleaned and changed. The still has also passing through its lid a tube, through which the hydrochloric acid is introduced; this tube terminates in the middle of a small vessel, so that the acid fills this vessel, and then overflows into the still. The end of the pipe thus dips below the acid in the vessel, and so a valve is formed which prevents the escape of chlorine through the pipe. At the bottom of the still is an outlet through which the manganese mud is removed at the end of the reaction.

See also, under Chlorine, the description of Weldon's stills, and of Deacon's apparatus.

CHLORITE. A salt of Chlorous Acid (which *see*).

CHLOROCARBONIC ACID. ($COCl_2$). Phosgene gas; carbonic oxydichloride. See Carbon Oxychloride.

CHLORODYNE. See Patent Medicines.

Chlorodyne. (*Dr Browne's.*) Acid. muriat. conc., 5 parts; ether, chloroform, tinct. cannab. Ind., tinct. capsici, of each, 10 parts; morphia, prussic acid, of each, 2 parts; oil of peppermint, 1 part; syrup 50 parts; tinct. hyoscyami, tinct. aconiti, of each, 3 parts.

Chlorodyne, English. A filtered mixture of 5 grms. tinct. aromat., 4 grms. tinct. opii simp., 1 grm. morph. mur., 10 grms. aq. amygd. amar., 80 grms. syrup of liquorice, 1 grm. extract of liquorice, 40 grms. 20% spirit of wine, 5 drops oil of peppermint, 10 drops ether, 30 drops chloroform.

Chlorodyne. (*R. de Puy.*) Chloroform, 4 oz.; ether, 1 oz.; alcohol, 4 oz.; treacle, 4 oz.; extract of liquorice, 2½ oz.; hydrochlorate of morphine, 8 gr.; oil of peppermint, 16 mimims; glycerine, 17½ oz.; hydrocyanic acid, 2%, 2 oz.

Chlorodyne. (*Dr J. H. Gilman.*) Chloroform, 2 oz.; ether, ½ oz.; alcohol, 8 oz.; oil of peppermint, 24 minims; tincture of capsicum, 6 dr.; compound tincture of cardamom, 2 oz.; fluid extract of liquorice, 2 oz.; dilute hydrocyanic acid, 1 oz.; glycerine, 16 oz.; sulphate of morphine, 40 gr.

CHLOROFORM. $CHCl_3$. *Syn.* Terchloride of formyle, Formyl-chloride, Chloroformyl, Trichloromethane, Chloroformum, L. A remarkable fluid discovered by Liebig in 1830, and independently by Soubeiran in 1832, and carefully examined in 1834 by Dumas. In 1842 its action upon animals was investigated by Dr M. Glover, and in 1847 it was introduced to the medical profession as an anæsthetic agent by Dr Simpson, of Edinburgh.

It was first obtained by the action of caustic alkali upon chloral, but it is more easily prepared by distilling alcohol or wood-spirit with calcium hypochlorite. It may also be procured from wood-spirit, acetone, oil of turpentine, and several essential oils, as well as from amylic alcohol, acetic acid, tartaric acid, and phenol; when these different bodies are severally subjected to the action of calcium hypochlorite. When chlorine is made to act on marsh gas, or when chloral is treated with an alkali, chloroform is also produced.

Prep. 1. Chloride of lime (in powder), 4 lbs.; water, 12 lbs.: mix in a capacious retort or still, add of rectified spirit, 12 fl. oz., and cautiously distil as long as a dense liquid, which sinks in the water it passes over with, is produced; separate this from the water, agitate it with a little sulphuric acid; and, lastly, rectify it from carbonate of barium.

2. Chloride of lime, 4 lbs.; water, 10 pints; rectified spirit, ½ pint; proceed at last, using a spacious retort that the mixture will only 1-3rd fill, and the heat of a sand-bath. When ebullition commences, remove the fire as quickly as possible, lest the retort be broken by the suddenly increased heat, and let the solution distil into a receiver as long as there is nothing which subsides, the heat being restored if it be at all needed. Add to the distilled liquid 4 times as much water, and shake the whole well together; next cautiously separate the heavier part as soon as it has subsided, and to this add chloride of calcium, broken into fragments, 1 dr.; and shake occasionally during an hour; finally, let the fluid again distil from a glass retort into a glass receiver.

3. Hydrate of lime, 1 part, is suspended in cold water, 24 parts, and chlorine passed through the mixture until nearly the whole of the lime is dissolved; hydrate of lime, q. s. just to restore the alkaline reaction of the liquid, is then added; and, afterwards, rectified spirit of wine or wood-spirit, 1 part, is mixed in; the whole, after repose for 24 hours in a covered vessel, is cautiously distilled as before.

4. (B. P.) Take of chlorinated lime, 10 *lbs.*; rectified spirit, 30 fl. oz.; slaked lime, a sufficient quantity; water, 3 galls.; sulphuric acid, a sufficient quantity; chloride of calcium, in small fragments, 2 *oz.*; distilled water, 10 fl. oz. Place the water and the spirit in a capacious still, and raise the mixture to a temperature of 100° F. Add the chlorinated lime, and 5 *lbs.* of the slaked lime, mixing thoroughly. Connect the still with a condensing worm, encompassed by cold water, and terminating in a narrow-necked receiver; and apply heat so as to cause distillation, taking care to withdraw the fire the moment that the process is well established. When the distilled product measures 50 fl. oz. the receiver is to be withdrawn. Pour its contents into a gallon bottle, half filled with water; mix well by shaking, and set it at rest for a few minutes, when the mixture will separate into 2 strata of different densities. Let the lower stratum, which contains crude chloroform, be washed by agitating it in a bottle with 3 fl. oz. of the distilled water. Allow the chloroform to subside, withdraw the water, and repeat the washing with the rest of the distilled water, in successive quantities of 3 oz. at a time. Agitate the washed chloroform for 5 minutes in a bottle with equal volume of sulphuric acid, allow the mixture to settle, and transfer the upper stratum of liquid to a flask, containing the chloride of calcium, mixed with ½ oz. of slaked lime, which should be perfectly dry. Mix well by agitation. After the lapse of an hour connect the flask with a Liebig condenser, and distil over the pure chloroform by means of a water-bath. Add $\frac{1}{10}$% by weight of ethylic alcohol. Preserve the product in a cool place in a bottle furnished with an accurately ground stopper. The lighter liquid which floats on the crude chloroform after its agitation with water, and the washings with distilled water, should be preserved and employed in a subsequent operation. Absolute chloroform by exposure to light undergoes rapid change, forming dangerous irritating chlorine compounds. It is found by adding a little alcohol this change is quite prevented.

Prop., &c. Liquid; transparent; colourless; odour fragrant, ethereal, and apple-like; taste ethereal, sweetish, but slightly acrid; soluble in 200 parts of water; mixes in all proportions with alcohol and ether; dissolves (readily) bromine, camphor, caoutchouc, gutta percha, iodine, oils, resins, wax, and several other like substances; boils at 141·8° F.; kindles with difficulty; burns, when strongly heated, with a greenish flame; and communicates a dull, smoky-yellow colour to the flame of alcohol. Sp. gr. 1·48 (1·497, Miller); density of vapour 4·2. The vapour has the remark-

able property of rendering a person breathing it temporarily insensible to pain.

Chloroform is frequently adulterated with alcohol and ether; and owing to careless manipulation, is also sometimes contaminated with other substances, as chloral, hydrochloric acid, free chlorine, aldehyde, and certain chlorinated oils. These latter compounds are not only the most objectionable and prejudicial of the impurities found in chloroform, but if present in it to any appreciable extent, they render its anæsthetic administration not only inefficient, but frequently absolutely dangerous. These deleterious chlorinated oily compounds may be removed by agitation with strong sulphuric acid, or by distillation from it. Chloroform made from wood-spirit is said to be more impure than that from alcohol. When pure it is free from colour, and of a pleasant odour. It is not perfectly soluble in water; and does not turn the colour of litmus red. Rubbed on the skin it quickly evaporates, scarcely leaving any odour. Dropped into water, it falls to the bottom and remains bright and limpid; but if it contains alcohol the surface of the drop becomes opaline. If the same experiment be made with diluted sulphuric acid, sp. gr. 1·44, the drop of pure chloroform will fall to the bottom; but that which contains spirit, if not shaken will float or remain suspended in the acid solution. When contaminated with heavy hydrocarbon oils, a drop evaporated from the palm of the hand leaves behind a strong smell. Hydrochloric acid and free chlorine are detected by the ordinary tests.

Mr Shuttleworth, writing to the 'Canadian Pharmaceutical Journal,' says: "In regard to restoration of chloroform which has become spoiled, I would recommend that the chloroform be well agitated with a dilute solution of hyposulphite of soda.

"It should then be separated by means of a glass funnel from the supernatant liquid, and again washed; this time with simple water. After being separated the chloroform should be passed through filtering paper to free it from traces of moisture, when it will be found much improved and comparatively sweet, good enough in any case for external use.

"There are, of course, certain other impurities of chloroform which the hyposulphite will not remove. These are of a more stable character, and as they possess a higher boiling point than chloroform, may be separated by distillation, or by treatment with sulphuric acid in the usual manner."

Concluding Remarks. The preparation of chloroform is not unattended with danger, and frequently miscarries in careless or inexperienced hands. This arises chiefly from the violent reaction which immediately follows the application of the heat. The common plan is attended with danger of explosion, or of the liquid in the still being forced over into the receiver, owing to the extraordinary rapidity with which the vapours are eliminated, and the ingredients, in consequence, swell up. A method which is successfully adopted on the large scale is to employ a very broad and shallow, capsule-shaped, still, having a flat rim round it, with a head or capital furnished with a corresponding rim at its lower part. In use a flat endless band of vulcanised india rubber is placed between the 2 rims, which are then held air-tight together by means of small iron clamps. The application of heat is also delayed for some time after the admixture of the spirit with the other ingredients, and the process is interrupted as soon as the first violence of the reaction has subsided, by which time the whole product of chloroform will have passed over into the receiver. If the distillation is continued beyond this point, the remaining product is water. On the small scale, a very capacious, flat-bottomed retort or cucurbit should be employed. A similar condenser may be used to that noticed under ether.

Uses, Actions, &c. Chloroform is anodyne, antispasmodic, sedative, stimulant, and anæsthetic. In small doses (5 to 12 or 15 drops, in water, mixed with a little syrup or mucilage) it is employed in spasmodic disorders, and as a stimulant and diaphoretic. It is now chiefly used as an anæsthetic to produce insensibility to pain during surgical operations. The dose for inhalation is 1 fl. dr., which is repeated, in a few minutes, if no effect is produced, until 3 fl. dr. have been thus exhibited; the effects being carefully watched, and the source of the chloroform vapour removed as soon as a sufficient degree of anæsthesia is produced, or any unpleasant symptoms develop themselves.

Chloroform in large doses depresses the heart's action, and causes profound coma, and death. It is therefore dangerous in all cases complicated with diseases of the heart or brain, or any visceral affections of a congestive character.

The treatment of asphyxia from chloroform is —the horizontal position, cold affusion to the head and spine, artificial respiration, and, if possible, either the application of electricity, or the inhalation of protoxide of nitrogen or oxygen gas, largely diluted with atmospheric air.

Chloroform of Aconite. (B. C.) Aconite root, 20 oz.; strong solution of ammonia, $1\frac{1}{2}$ fl. oz.; distilled water, 1 pint; chloroform, a sufficient quantity.

Bruise the root, and moisten thoroughly with the strong solution of ammonia and distilled water previously mixed. Macerate for 4 hours, dry carefully, and reduce to No. 40 powder. Pack tightly in a percolator provided with a tap and closely-fitting cover. Macerate for 24 hours with 20 fl. oz. of chloroform; then pour successive quantities of chloroform, percolating slowly until 30 fl. oz. are obtained.

Chloroform of Belladonna. (B. C.) Prepared as chloroform of aconite (q. v.), substituting belladonna root for aconite.

The above liniments are employed as local anodynes for neuralgic and rheumatic pains.

Chloroform of Camphor. (B. C.) Camphor, 2 oz.; chloroform, 1 fl. oz. Placed on cotton wool is used to relieve toothache.

CHLOROFORMIC ANODYNE (*George Harley*), is said to be an alcoholic tincture of opium with prussic acid and chloroform.

CHLOROPHYLL. The green colouring-matter contained in the leaves, stalks, unripe fruit, and juices of most plants.

CHLOROPS LINEATA. The Lined Corn Fly. This is another species of *Chlorops* almost identical

in appearance with the *Chlorops tæniopus*, as well as in its destructiveness to corn crops. It is, however, found most frequently upon barley plants. The remarks below as to the life, history, means of prevention, remedies, and parasites equally apply to this insect ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CHLOROPS TÆNIOPUS, Curtis. The Ribbon-footed Corn Fly. This fly is often most injurious to wheat, barley, and rye-plants. It is called ribbon-footed because it has a band of light hue upon its dark feet. It is of a yellowish colour, with dark brown bands running down its back, and is thick and inelegant in shape. The larva or grub, the cause of the injury, is light yellow with a pointed head with rows of points placed diagonally upon the upper part of the body, and without legs, yet having considerable powers of locomotion. This grub, about 1·8th inch in length, bites its way down the stems of corn-plants, from the base of the ear to the first joint, causing the disorder known to agriculturists as gout in the joints, from the swollen and distorted growth of the stems and sheathing leaves. It has been noticed that stems of wheat having these larvæ within them rarely develop ears containing perfect grains. Barley plants also suffer in some seasons from these *Chlorops* maggots, which appear directly the plants begin to stock out, and burrowing in the stem hinder the formation of ears. In 1845, from half to two-thirds of this crop was destroyed in various localities in the east of England by the *Chlorops.* This insect is known and dreaded in America, Germany, and France.

Life History. The perfect insect, the fly, makes its appearance usually about the beginning of May and lays eggs, 1 or 2 white eggs at a time, on the outsides of the leaves of the corn-plants enwrapping the shoots containing the embryonic ears. The larva is hatched in a few days after the deposition of the eggs, and pushes into the shoot, in which it forms burrows, making for the ear, upon whose sweet juices it feeds. In due course, and generally after the plant has become irretrievably injured, the larva becomes a pupa, and the perfect stage is assumed about the beginning of August. The pupa is of a darker, more of an orange, yellow than the larva, and has a hard stiff case. It is yet a moot point as to the form in which, and where, the winter is passed. Taschenberg holds that there are 2 generations, that of the winter and that of the summer, and that the flies found in August lay eggs upon grasses from which larvæ are hatched, and thus pass the winter in the stalks, and penetrate even to the crown of the roots for shelter. Curtis also thinks this is probable.

Prevention. Clean farming and high farming are, as in many cases, the principal means of prevention. The first tends to prevent the propagation of the corn flies by the removal of weeds and grasses in the fields, and by the sides of fields. The second tends to make the plants vigorous and healthy, and less liable to be attacked. Though these are flies, having ample wings, it would seem that they do not get very far from their birth-places, or winter retreats, except when carried away in harvested corn; therefore cultivating stubbles and removing rubbish, and deep ploughing after a bad attack would tend especially to prevent a recurrence. When corn-stems are badly affected with gout, the straw, ears, 'cavings,' and chaff should be examined for the presence of flies and larvæ, and dealt with if these are present. After a bad attack, if the sheaves of wheat and barley are shaken when taken from the rick, many of these insects will fall from the ears and straw. Care should be taken in these cases to destroy all the rubbish after taking in or threshing a rick.

Small fields of corn and those surrounded with hedges and ditches are far more liable to be attacked by the *Chlorops* than large corn-fields far from possible shelter. Wet places in fields are most liable to be attacked by this insect, therefore drainage is essential for this as for every other consideration. In one instance a farmer had the plants in a wheat-field infested with *Chlorops* pulled up and carried away and burnt. Affected plants are easily seen, and may be pulled up without difficulty, but the expense would be considerable.

Remedies. Remedial measures are obviously almost impracticable. The onslaught of the *Chlorops* comes usually at a time when it is difficult to deal with the corn plants in any way likely to dislodge or to destroy it. When the attack is noticed early, and this requires careful and constant observation, dressings of stimulating manure would force the plants along rapidly. But this, of course, could not be done safely or easily after they had got high. Blading, or "flagging," the plants when an attack threatened to be severe, if done promptly and before they were too far advanced, would remove many eggs.

Parasites. Nature, in this dilemma, comes to the assistance of the farmer when he can hardly help himself, with timely parasites which feed upon the *Chlorops'* larvæ. There are, 1st, *Cœlinius niger*, a dark brown fly, nearly ¼ inch in length, rather larger than the *Chlorops.* It lays an egg in the body of the *Chlorops'* larva, and changing into a larva lives upon it. Having eaten the contents of the body of its host it becomes a pupa, and soon after a perfect insect, flying to fresh fields and pastures new. 2nd, *Pteromalus micans*, so called because of its refulgent green colour. This parasite, about the size of the *Chlorops,* or rather less than 1-6th inch in length, also places an egg in the body of each *Chlorops'* larva, and, becoming a larva in a very short time, lives upon its substance and reduces it to a mere empty skin. The *Pteromalus* is fortunately very plentiful ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.)

CHLORO'SIS. *Syn.* Green sickness. A disease which principally affects young unmarried females.

Symp. Languor, listlessness, fatigue after the least exercise, palpitation of the heart, flatulency, indigestion, acidity of stomach and bowels, constipation (generally), appetite for unnatural food, general debility, &c. As the disease advances, the skin, at first pale, assumes a peculiar greenish tint, the respiration becomes affected, the feet and legs swell, and various organic affections of the viscera ensue. During the early stages of this

disease the catamenia are usually pale and scanty, and return at irregular intervals, and as it progresses they disappear altogether.

Treat. This should be tonic and restorative. Good plain food, tonics and abundance of fresh air and healthy exercise are preventives, and will often effect a cure in the earlier stage. That recommended under ANÆMIA may be adopted with advantage. See also APPETITE, ATROPHY.

Chlorosis, Electuary for—Female Electuary. A greenish-black thick syrup, consisting of sugar, bayberries, carbonate of iron, iron filings, and water (*Buchner*).

Chlorosis Powder—Female Powder—consists of a mixture of anise, sugar, and 14% of iron filings (*Wittstein*).

Chlorosis Powder—Female Powder, according to Schott and Strauss, is a mixture of violet root, gum arabic, and a tasteless green powder with 33% of steel filings. According to Hager, it is composed of 2 parts ferri pulvis, with 3 parts powdered sweet-flag root.

Chlorosis Powder—Female Powders. Steel filings, starch powder, and knot grass, of each, 1 part; Florentine orris root, 4 parts.

Chlorosis Powder—Female Powders. A mixture of 1 part steel filings and 2 parts of a vegetable powder composed of gum-arabic, Florentine orris, knot grass, &c. (*Egb. Hoyer*).

Chlorosis Water (*Dr Ewich*) contains in 10,000 parts 11 of sodium carbonate, 9 of sodium chloride, 1½ sodium sulphate, 7 calcium carbonate, and 1·2 iron carbonate with an excess of carbonic acid (*Hager*).

CHLOROUS ACID. $HClO_2$. *Syn.* ACIDUM CHLOROSUM, L. *Prep.* Potassium chlorate (4 parts) is mixed with arsenious anhydride (3 parts), and water added to the mixture so as to form a thin paste; the paste is then gently heated in a flask containing 12 parts of dilute nitric acid of sp. gr. 1·327 and 4 parts of water. The arsenious anhydride is oxidised to arsenic anhydride, and the nitric acid is at the same time reduced to nitrogen trioxide, which in its turn reduces the chlorate, forming chlorous acid and regenerating a nitrate. Chlorine trioxide distils over from the flask, and is collected in water, in which it dissolves, forming chlorous acid. Instead of arsenious anhydride other deoxidising substances, such as sugar, starch, or tartaric acid may be used.

Prop., &c. Chlorous acid is a greenish-yellow gas, non-condensible by a freezing mixture of salt and ice, but liquefiable by extreme cold. The aqueous solution undergoes gradual decomposition, yielding chloric acid and chlorine. Chlorous acid possesses powerful oxidising and bleaching properties; with the bases it forms salts, called CHLORITES. These are all soluble in water, and bleach like the acid. They may be recognised by the evolution of chlorous acid gas when acted on by an acid.

CHOC'OLATE. *Syn.* CHOCOLA'TA, L.; CHOCOLLATI, Mexican; CHOCOLAT, Fr. A beverage or paste made from the roasted seeds of the *Theobroma cacao*, or COCOA. Strictly speaking, the term 'chocolate' is applicable to all genuine preparations of cocoa, but it is now generally used to distinguish those which contain sugar, and, commonly, flavouring substances. Of late years great attention has been paid to the manufacture of chocolate in England; our principal makers now import the finest descriptions of cocoa, and produce varieties of the manufactured article which are scarcely inferior to those of their French rivals. The different kinds of cocoa, and the processes of roasting, sweating, &c., are described under COCOA, to which article we refer the reader also for particulars respecting the chemistry of chocolate.

Prep. The cocoa nibs (the bruised, roasted seeds, freed from husk and membrane) are ground in a mill consisting of stone or metal rollers, which are usually heated either by charcoal fires or by steam, so as to soften or melt the natural fat (cacao or cocoa-butter.) The warm, smooth paste which passes from the mill is then placed in a mixing mill and incorporated with refined sugar, and usually vanilla or other flavouring substance. The trituration is continued until the whole paste is converted into an entirely homogeneous mass, which is finally shaped by means of suitable moulds, into various forms, as blocks, loaves, tablets, lozenges, &c.

Obs. Chocolate, prepared as above, without the addition of aromatics, is known in the trade as PLAIN CHOCOLATE. The Spaniards flavour it with vanilla, cloves, and cinnamon, and frequently scent it with musk and ambergris. With these additions it is termed SPANISH CHOCOLATE. In general, they add too large a quantity of the last four articles. The Parisians, on the contrary, use little flavouring, and that principally vanilla. They employ the best kinds of cocoa, and add a considerable quantity of refined sugar. So prepared, it is called FRENCH CHOCOLATE.

Prop. 1. FRENCH CHOCOLATE. The proportions used for the best description are said to be—2 beans of vanilla and 1 lb. of the best refined sugar to every 3 lbs. of the choicest cacao nuts.

2. SPANISH CHOCOLATE. The following forms are said to be commonly adopted:

a. Caracas cocoa, 11 lbs.; sugar (white), 3 lbs.; vanilla, 1 oz.; cinnamon (cassia), ¼ oz.; cloves, ½ dr.

b. Caracas cocoa, 10 lbs.; sweet almonds, 1 lb.; sugar, 3 lbs.; vanilla, 1¼ oz.

c. Caracas cocoa, 8 lbs.; island cocoa, 2 lbs.; white sugar, 10 lbs.; aromatics, as above.

d. Island cocoa, 7 lbs.; farina, q. s. to absorb the oil. Inferior.

3. VANILLA CHOCOLATE. *Syn.* CHOCOLAT À LA VANILLE, Fr. A variety of French or Spanish chocolate highly flavoured with vanilla. The following proportions have been recommended:

a. Caracas cocoa, 7 lbs.; Mexican vanilla, 1 oz.; cinnamon, ½ oz.; cloves, 3 in number.

b. Best chocolate paste, 21 lbs.; vanilla, 4 oz.; cinnamon, 2 oz.; cloves, ½ dr.; musk, 10 gr.

Obs. The vanilla used in making chocolate is reduced to powder by rubbing it with a little sugar before adding it to the paste.

Pur., &c. The chocolate commonly sold in England is prepared from the cake left after the expression of the oil, and this is frequently mixed with the roasted seeds of ground peas and maize or potato flour, to which a sufficient quantity of inferior brown sugar, or treacle and mutton suet

added to make it adhere together. Inferior sweet almonds are also employed in the same way.

Since the above paragraph was written there has been a vast improvement in English chocolates, though the cheaper sorts of certain makers are still much adulterated. Genuine chocolate should dissolve in the mouth without grittiness, and should leave a peculiar sensation of freshness; after boiling it with water the emulsion should not form a jelly when cold, for if it does starch or flour is present. The presence of animal fat may generally be detected by a cheesy or rancid flavour. See COCOA.

Qual., &c. Chocolate is nutritive and wholesome if taken in moderation, but is sometimes apt to disagree with weak stomachs, especially those that are easily affected by oily substances or vegetable food. When this is the case, by adopting the simple plan recommended under BUTTER, chocolate may generally be taken with impunity, even by the dyspeptic. The quantity of aromatics mixed with the richer varieties of chocolate improve the flavour, but render them more stimulant and prone to produce nervous symptoms and head complaints.

Chocolate is taken in the solid form, or made into a beverage; or, combined with sugar, is made into various articles of confectionery.

CHOCOLATE FOR THE TABLE is prepared by slicing or scraping very finely the required quantity into a jug, and adding to it a small quantity of boiling water. This is worked into a thin, smooth paste, and the jug immediately filled up with boiling milk-and-water. A froth is produced by the same means that eggs are beaten up. The operation of 'milling,' performed by rapidly twirling a notched cylinder of wood in the emulsion, raises the froth very quickly. Sugar may be put in with the scraped chocolate, or added afterwards at pleasure.

Chocolate should never be made for the table before it is wanted, because beating it again injures the flavour, destroys the froth, and separates the body of the chocolate, the oil of the nut being observed, after a few minutes' boiling, or even standing long by the fire, to rise to the top. This is one of the principal reasons why chocolate offends the stomach.

Preparations of chocolate, intended either as nutritious articles of food for convalescents or as vehicles for medicine, are common among the pharmacopœial and magistral formulæ of the Continent. The following are a few examples:

Chocolate, Aromat'ic. *Prep.* (*Weiglebt.*) Cocoa beans and sugar, of each, 16 oz.; cinnamon, ½ oz.; cloves, 2 dr.; cardamoms and vanilla, of each, 1 dr.

Chocolate, Carrageen. See CHOCOLATE, WHITE (Nos. 1 and 2).

Chocolate, Chalyb'eate. *Syn.* FERRUGIN'EOUS CHOCOLATE; CHOCOLA'TA CHALYBEA'TA, C. MAR'TIS, L. *Prep.* 1. (*Trousseau.*) Spanish chocolate, 16 oz.; carbonate of iron, ½ oz.; mix, and divide into 1-oz. cakes. One at a time; in anæmia, amenorrhœa, chlorosis, &c.

2. (*Pierquin.*) Iodide of iron, 2 dr.; chocolate, 16 oz. For ½-oz. cakes; as above, and in scrofulous and glandular affections.

Chocolate, Guarana'. *Syn.* PAULLIN'IA CHOCOLATE; CHOCOLA'TA PAULLIN'IÆ, C. GUARANÆ, L. *Prep.* From guarana and white sugar, of each 1 oz. triturated together, and afterwards thoroughly mixed with good plain chocolate, 18 oz. Recommended as a restorative in debility, chlorosis, and other diseases of debility, especially those of a nervous character.

Chocolate, Ice'land Moss. *Syn.* CHOCOLA'TA CETRAR'IÆ ISLAND'ICÆ, C. LICHEN'IS, L. *Prep* 1. (P. C.) Simple chocolate (P. C.), 32 parts; sugar, 29 parts; dried jelly of Iceland moss, 11 parts; mix.

2. (*Cadet.*) Chocolate, 4 lbs.; sugar, 2 lbs., Iceland moss (freed from its bitter and powdered); 1½ lbs.; tragacanth and cinnamon, of each, 4 oz.; water, q. s.; to be beaten in a warm mortar, or ground with a muller on a warm slab to a paste. Recommended in pulmonary affections, general debility, weakness of stomach, &c. See COCOA (Iceland moss).

Chocolate, Kola. Kolatina, introduced by Messrs. Christy, of Fenchurch Street, London, is prepared from Kola nuts, q. v.; it is said to have the following properties:

Kolatina is far more nutritious than cocoa as it contains, in addition to the ingredients of the latter, over 2% of caffeine, the active ingredient of coffee, which has not itself so large a percenage of it as the kolatina.

Kolatina does not, like tea, produce disturbances of the digestive organs and excessive nervous irritation, but acts as a pleasant and effective substitute for it, without its ill effects.

Persons who suffer from dyspepsia will find it a more assimilating beverage than tea, coffee, or cocoa, and will gain increased strength, appetite, and health, from taking it for a time.

Persons suffering from chronic or periodical headaches, dipsomania, palpitation, loss of appetite, nausea, giddiness, disturbance of the nerves, and overwork, who cannot take beverages like tea, coffee, or cocoa, will find kolatina and kola chocolate very palatable and effective substitutes.

Chocolate, Pur'gative. *Syn.* CHOCOLA'TA PUR'GANS, C. CATHAR'TICAL, L. *Prep.* 1. Jalap, 1 oz.; chocolate, 9 oz.; mix, and divide into 1-dr. cakes.—*Dose*, 1 to 2 cakes, as a purge.

2. Jalap, 2 oz.; calomel and sugar, of each, 1 oz.; triturate together, then add chocolate, 20 oz.; for 1-dr. cakes.

3. Scammony, 2 dr.; chocolate, 3 oz.; for 1 doz. cakes. The last two are given in worms.—*Dose* (for an adult), 1 cake, taken fasting.

Chocolate, Sal'ep. *Syn.* SAL'OOP CHOCOLATE; CHOCOLA'TA CUM SAL'EP, L. *Prep.* 1. (P. C.) Chocolate, 16 oz.; powdered salep, ½ oz.

2. (*Cadet.*) Cacao paste and sugar, of each, 1 lb.; powdered salep, 1 oz. Arrowroot chocolate and tapioca chocolate are made in the same manner. (See *below.*)

Chocolate, Sim'ple. *Syn.* HYGIEN'IC C., HOMŒOPATH'IC C.; CHOCOLA'TA, C. SIM'PLEX, C. SALU'TIS, L; CHOCOLAT DE SANTÉ, Fr. *Prep.* (P. C.) Caracas and Maragnan cocoa, of each, 96 lbs.; sugar, 160 lbs.; cinnamon, 1 oz. (to 2 oz.); triturated together in the usual manner, and formed into cakes or powder.

Chocolate, Vanil'la. *Syn.* CHOCOLA'TA CUM

VANIL'LA L. *Prep.* 1. (P. C.) Chocolate (plain, —P. C.), 16 oz.: vanilla, $\frac{1}{2}$ dr.

2. (*Cotterau.*) Cocoa paste, 6 lbs.; sugar 10 lbs.; vanilla, 11 dr.

See forms previously given.

Chocolate, Ver'mifuge. *Syn.* CHOCOLA'TA VERMIFU'GA, L. See CHOCOLATE, PURGATIVE (Nos. 2 and 3, *above*).

Chocolate, White. *Syn.* WHITE COCOA, CAR'-RAGEEN C.; CHOCOLA'TA CUM CHON'DRO, PAS'TA CACA'O CUM CHRON'DRO, P. C. C. LICHEN'E CAR-RAGHEN'O, L. *Prep.* 1. As Iceland moss chocolate, but employing carrageen moss.

2. (Ph. Dan.) Roasted and decorticated cocoa seeds (reduced to a subtile mass in a warm iron mortar) and powdered white sugar, of each, 2 lbs.; powdered carrageen (debitterised), 3 oz.

3. (*Cotterau.*) Sugar, 6 lbs.; rice flour, $1\frac{3}{4}$ lbs.; potato-starch and butter of cocoa, of each $\frac{1}{2}$ lb.; gum-arabic, $\frac{1}{4}$ lb. (dissolved); tincture of vanilla, $\frac{1}{2}$ fl. oz.; boiling water, q. s.; triturate to a stiff paste. The above are highly nutritious, and are recommended as articles of diet for convalescents and debilitated persons.

CHOKE-DAMP. *Syn.* AFT'ER-DAMP. The term applied by miners to carbonic anhydride (carbonic acid) and other irrespirable gases and vapours evolved in mines. See CARBONIC ACID, FIRE DAMP, VENTILATION, &c.

CHOKING. Threatened choking may occur either in the gullet or swallow—or in the windpipe. If in the gullet press down the tongue with the handle of a spoon, and pass the fingers down without any hesitation, when the substance may generally be dislodged or pulled up. When it is small, and has got out of reach, it may mostly be removed by filling the mouth with liquid and swallowing it at a gulp, or by swallowing a large piece of bread. Foreign bodies thus swallowed generally pass harmlessly through the bowels.

If the choking occur in the windpipe or trachea, it is usually dislodged by the paroxysm of coughing which accompanies the act. Should it fail to be so, and a sense of suffocation ensues, accompanied with blueness of countenance and difficulty of breathing, place the patient, and follow the directions given in the article "SUSPENDED ANIMATION," while a medical man is immediately sent for.

Treatment for Horses or Cattle. Remove any foreign body by hand, as directed above, or have recourse to the probang. It may perhaps be necessary to call in a veterinary surgeon, in case the above methods fail, to extract the obstruction by cutting into the gullet.

CHOLAGOGUES. Medicines which promote a flow of bile.

CHOLALIC ACID. $C_{24}H_{40}O_5$. *Syn.* CHOLIC ACID. A non-nitrogenous acid existing in bile. It is best prepared by boiling the resinous mass precipitated by ether from an alcoholic solution of ox bile with a dilute solution of potassa for 24 to 36 hours, till the amorphous potassa salt that has separated begins to crystallise. The dark-coloured soft mass is then removed from the alkaline liquid, dissolved in water, and hydrochloric acid added. A little ether will cause the deposition of the CHOLALIC ACID from this solution in crystals. With sulphuric acid and solution of sugar it strikes a purple-violet colour; this constitutes Pettenkofer's test for bile.

CHOLE'IC ACID. $C_{26}H_{45}NSO_7$. *Syn.* TAURO-CHOLALIC ACID. A peculiar conjugated compound of cholalic acid with a substance called taurine, which contains both nitrogen and sulphur. In combination with soda, choleic acid constitutes a principal ingredient in bile.

CHOLERA, ASIATIC. *Syn.* SEROUS CHOLERA, SPASMODIC CHOLERA, MALIGNANT CHOLERA, CHOLÈRA, ASIATIQUE, Fr.; ASIATISCHE CHOLERA, Ger.

Definition. The following definition of Asiatic cholera is given by Dr C. Macnamara in Quain's 'Dictionary of Medicine.' "Asiatic cholera is a specific disease, characterised by violent vomiting and purging, with rice-water evacuations, cramps, prostration, collapse, and other striking symptoms; tending to run a rapidly fatal course; and capable of being communicated to persons otherwise in sound health through the dejecta of patients suffering from the disease. These dejecta are most commonly disseminated among a community and taken into the system by means of drinking water, or in fact by anything swallowed which has been contaminated by the organic matter passed from cholera patients. In badly ventilated rooms, the atmosphere may become so fully charged with the exhalations from patients suffering from cholera as to poison persons engaged in nursing the sick. In the same way, the people engaged in carrying the bodies of those who have died of the disease for burial, or in washing their soiled linen, may contract the malady. In a dried condition the organic poison contained in cholera excreta may retain its dangerous properties for a long time."

Asiatic cholera was unknown in Europe before 1829–30, although it has existed in India for centuries. Cholera broke out in the years 1840–41 in China, having probably been carried to that country from India; it spread westwards through Asia, reaching Europe in 1848.

The next great epidemic occurred in the years 1853–4, the disease appearing again in 1864–5–6. In 1884–5 it again visited Europe, causing the most terrible mortality, especially in Naples and the neighbourhood.

Symptoms. In the early and more deadly stages of the epidemic, patients exhibit few or no premonitory symptoms. They may retire to rest perfectly well and rise in the morning to be attacked suddenly with violent purging and vomiting, to be followed perhaps by death in a few hours. Later on, in the course of the epidemic, prostrating diarrhœa is a common disorder, and should be promptly treated as the first sign of the disease; it is in this first stage of the disease that medical assistance is of most service, and during an epidemic the most trifling looseness of the bowels should be attended to and stopped by suitable remedies. In the second stage the stools become very frequent and watery, resembling the water in which rice has been boiled, violent vomiting supervenes accompanied by extreme prostration.

The patient complains of intense thirst, and suffers great pain from cramps in the limbs; he will complain of feeling very hot and throw off

the bed-clothes, although his body temperature is below the normal; the pulse is rapid and weak, the respiration hurried, and the voice husky; this second stage may last 2 or 3 hours only, or may continue for 12 to 15, but, so long as the pulse can be felt at the wrist, there is hope of saving the patient's life; the failure of the pulse indicates the passage into the third, or collapse stage, from which barely one third ever recover. In this stage the pulse cannot be felt, the whole body becomes livid and shrunken, the voice is almost inaudible, the breathing very rapid, the urine is suppressed, and the temperature may fall as low as 94° F. The intellect remains clear; there is rarely any anxiety on the part of the patient, though he is fully conscious of his great danger, and "sleep and a plentiful supply of water to drink are the sole desires of a person passing through the collapse stage of cholera."

In this stage the patient commonly dies, the body first rising in temperature to about 100° F. If, after the collapse stage has lasted for some hours, the temperature begins to rise very gradually, and the respiration to diminish in frequency, with a stronger pulse, and a tendency to sleep, the patient will slowly recover his bodily functions and be restored to health. In the reaction stage, however, various complications may arise, such as inflammation of the lungs and bowels, abscesses in various parts of the body, and the formation of clots in the right side of the heart, which may endanger the patient's life, and even cause his death.

Treatm. In the first stages of Asiatic cholera, the stopping of the purging is of the greatest importance, and opium is perhaps the best and most reliable remedy. Large mustard poultices over the abdomen, absolute rest, and complete abstinence from food and drink, but with as much ice to suck as the patient may desire is the proper treatment.

If the opium fails Dr. Macnamara advises 3 gr. of acetate of lead, and 15 drops of dilute acetic acid in water every second hour, and 15 drops of dilute sulphuric acid in water every alternate hour, so that the patient should take a draught first of one mixture and then of the other every hour. The vomiting is best relieved by the abdominal mustard poultice, and by the sucking of ice; the cramps are best relieved by hand friction. In the collapse stage little can be done; opium should not be given, but the sucking of ice may be continued. Dr Macnamara is of opinion that wine and stimulants do harm in this stage. In the stage of reaction, the greatest possible caution must be exercised, the stomach must not be irritated by attempts to give food, and small quantities of iced milk with nutritive enemata every 5 or 6 hours seems to be the best treatment to adopt.

Prevention. Whatever may be the precise cause of cholera, the danger of filth, and particularly of the evacuations of choleraic patients, is certain. Every possible care should be taken during the prevalence of an epidemic to ensure that the water and milk supply is safe from contamination. All house refuse and filth of every description should be destroyed or throughly disinfected, and the very slightest tendency to diarrhœa should be promptly treated. With regard to soiled linen, bedding, and evacuations, these should be at once saturated with some powerful disinfectant, such as ferrous sulphate, or, better still, burnt. In no case should any accumulation of such material be allowed, and even the dead bodies of cholera patients should be thoroughly disinfected, buried in a mixture of lime and charcoal, and that within 24 hours of death if possible.

General. Although cholera is one of the most terrible epidemic disorders, there is abundant evidence to show that much can be done in the way of prevention, and with our modern sanitary appliances, a fairly perfect system of drainage, combined with the strictest attention to the personal cleanliness, and the immediate removal of filth and garbage of every kind from the precincts of dwelling-houses, we have comparatively little to fear from epidemic cholera, which is essentially attracted by filth, and, terrible though the disease is, there is no ground in a cleanly population for the hopeless terror and panic which it creates among uncivilised, and dirty people.

Cholera Medicines. When the epidemic was most severe in Paris, July 16, 1884, the Municipal Sanitary Commission decided to distribute gratuitously the most necessary medicines. A mixture and a liniment were prepared, which were known as 'Bottle No 1' and 'Bottle No. 2.' The formula of Bottle No. 1 was: Sydenham's laudanum, 3 grms.; ether sulphuric, 1 grm.; essence of peppermint, 20 grms.; syrup of orange-flower, 20 grms. The formula of Bottle No. 2 was: spirit of turpentine, 200 grms.; pure olive oil, 200 grms.

Printed directions were given with the other bottles: "(1) If diarrhœa comes on, steep a lump of sugar in the anti-cholera drops (Bottle No. 1), swallow it, and repeat twice or thrice at intervals of 20 minutes. (2) If vomiting occurs send for the doctor, and, until he arrives, give every half-hour a teaspoonful of the medicine in 2 dessert-spoonfuls of tea, a teaspoonful of rum or cognac. Administer an enema of 10 drops of laudanum with 50 grms (6 oz.) of tepid water. Apply to the stomach a large poultice of linseed meal sprinkled with laudanum. (3) If the doctor has not yet arrived, and cramps and chills come on, give the rest of the medicine, a teaspoonful at a time every ¼ hour, with broken ice or aërated waters in place of the alcoholised tea. Vigorously rub the limbs, at first with the dry hand, afterwards with oil and turpentine (Bottle No. 2). After the second rubbing wrap the patient closely in woollen coverings."

The following remedies have been used in various epidemics:

1. (American remedy.) Equal parts of maple-sugar and powdered fresh-burnt charcoal, made into a stiff paste with lard, and divided into pieces the size of a filbert.—*Dose*, 1 occasionally, swallowed whole.

2. (Austrian specific.) The proportions of the ingredients in the following formulæ are founded on Mr Herapath's analysis of this celebrated preparation, and are given in the nearest available whole numbers:

a. Sulphuric acid (sp. gr. 1·845), 20 gr.; nitric

acid (sp. gr. 1·500), 12 gr.; sugar and gum, of each, 15 gr.; distilled or pure soft water, q. s. to make the whole weigh exactly 1 oz.

b. Sulphuric acid, 3 dr.; nitric acid, 2 dr.; simple syrup, 6 dr.; water, q. s. to make the whole weigh exactly 10 oz. A single drop of essential oil of lemon may be added.

Doses, &c. 1 tablespoonful is ordered to be taken in water, on the first appearance of premonitory symptoms, followed by the free use of very cold water. In half an hour a second dose is to be taken. This (as asserted) is generally sufficient to arrest the progress of the disease. A tablespoonful is then to be added to a pint of cold water, and drank *ad libitum.* In more obstinate cases it is said that 4 or 5 doses are generally required to effect a cure. When collapse sets in, double doses are ordered to be given, and to be repeated after every attack of vomiting until the sickness and cramps abate. After the vomiting abates the doses are still to be repeated until 5 or 6 doses are retained by the stomach. Should quiet sleep or drowsiness come on, it is not to be interfered with. The free use of cold water or soured water is to be allowed until perspiration sets in and the warmth of the body returns. According to the report, the use of warm liquors, wines, spirits, &c., must be carefully avoided as so much poison.

Obs. A bottle of the above remedy was handed to the late Mr Wm. Herapath by the superintendent of the Birmingham police, who had received it from the head of the Austrian police, as being in general use in Austria, under the sanction of the medical department of the Government, and being found to act almost as a specific in cholera. In 1831-2 it was first tried on some criminals with perfect success, and soon afterwards with similar results on thousands of the general public. In 1849 the Austrian Government ordered its use in the public establishments of the empire, since which not a single case of failure had occurred in which it had been fairly tried.

3. (*Mr Buxton's* remedy.) From dilute sulphuric acid (spirit of vitriol), 25 drops; water, 1 fl. oz. For a draught; as the last.

4. (College of Physicians and Board of Health; for premonitory diarrhœa.) Chalk mixture, 1 oz.; aromatic confection, 10 to 15 gr.; tincture of opium, 5 to 15 drops; to be repeated every 3 or 4 hours, or oftener, if required, until the looseness is arrested.

5. (*Dr Graves's* astringent pills.) Acetate of lead, 20 gr.; opium, 1 gr.; conserve of roses, q. s.; for 12 pills.—*Dose,* 1 every ½ hour or hour at first; then 1 every 2 hours.

6. (Homœopathic preventive.) Camphor, 1 dr.; rectified spirit, 6 dr.; dissolve, and preserve it in a well-corked bottle.—*Dose,* 2 drops on a lump of sugar, sucked as a lozenge, 2 or 3 times a day.

7. (Homœopathic remedy.) As the last, repeating the dose every 10 or 15 minutes, followed by draughts of ice-cold water, until the symptoms abate.

8. (*Mr Hope's* remedy.) *a.* Red nitrous acid, 2 dr.; peppermint water or camphor julep, 1 oz.; tincture of opium, 40 drops; mix.—*Dose,* 1 to 2 teaspoonfuls in a cupful of thin gruel every 3 or 4 hours.

b. Spirits of wine, 1 oz.; spirit lavender, 1 oz.; oil or orizinanum, ¼ oz.; compound tincture benzoin, ½ oz.; spirits of camphor, ¼ oz.—*Dose,* 20 drops on moist sugar. To be rubbed outwardly also.

9. (Liverpool preventive powders.) Bicarbonate of soda, 20 gr.; ginger, 10 gr.; for a dose, 1 to be taken in a glass of water after breakfast and supply daily.

These powders are said to have been used with good effect among the workmen in the mining and manufacturing districts during a former visitation of cholera.

10. (Police remedy; *Mr B. Child's* remedy.) Rectified sulphuric ether and tincture of opium, of each, 30 drops; for a dose for an adult; especially during the earlier stages.

11. (*Mr Ross's* astringent pills.) Each pill contains 1 gr. of nitrate of silver, made up with crumb of bread, q. s.—*Dose,* 1 pill, to be repeated after the interval of ½ hour or an hour, should the symptoms continue unabated.

12. (Russian remedy.) Sumbul, in the form of tincture, concentrated essence, in decoction, in cold infusion, and in powder in the form of pill. —*Doses.* Tincture, from 20 to 60 drops; essence, from 5 to 10 or 20 drops; in a little camphor julep or plain water. The physicians of Moscow and St. Petersburg ascribe to the virtues of this drug the saving of thousands of lives during the last epidemic. See SUMBUL.

13. (*Dr Stevens'* saline powders.) Bicarbonate of soda, ½ dr.; common salt, 20 gr.; chlorate of potassa, 7 gr.; for a dose.

14. (*Sir M. Tierney's* remedy.) Cajeput oil, in doses of 20 to 30 drops, every 2 or 3 hours. The oil excites the nervous system and equalises the circulation. The late Sir M. Tierney and others prescribed it frequently, it is said with considerable success.

15. (Common remedies of the shops.) These generally consist of chalk-mixture, with a little laudanum, and some aromatic or carminative, as cassia, cinnamon, cardamoms, nutmeg, or peppermint. In a few, some astringent, as tincture of catechu, or extract of logwood, is added.

16. (*Dr Beaven's* preventive and remedy). *The Preventive.*—Sulphite of magnesia, 2 dr.; sulphurous acid, 2 oz.; water, 2 oz.; tincture of capsicum, ½ oz. Mix and dissolve; a teaspoonful night and morning.

The Remedy. Sulphite of magnesia, 2 dr.; sulphurous acid, 2 oz.; water, 2 oz.; tincture of capsicum, ½ oz.; sulphate of morphia, 2 gr. Mix and dissolve; a teaspoonful of every ½ hour until relieved.

CHOLERAIC DIARRHŒA. See DIARRHŒA.

CHOLES'TERIN. $C_{26}CH_{44}O.H_2O$. This substance is found in the bile, brain, nerves, blood, &c., and forms the principal ingredient of biliary calculi (gall-stones). It is a lævorotary alcohol, crystallising in transparent rhombic parts, insoluble in water, soluble in hot alcohol, in ether, and chloroform. With sulphuric acid and iodine it gives a characteristic blue reaction.

CHOL'IC ACID. *Syn.* GLYCO-CHOLAL'IC ACID A peculiar acid, existing as cholate of sodium, and associated with choleic acid in the bile. It is a conjugate compound of cholalic acid with a nitrogenised substance called glycocin.

CHON'DRIN. A body resembling gelatin in its properties obtained from cartilage. It differs from ordinary gelatin in being precipitable by acetic acid, alum, and acetate of lead.

CHOREA. *Syn.* St Vitus's Dance. A nervous disease affecting children and young persons between 8 and 12 years of age; rare before 6 years of age and after 16, and twice as frequent in girls as in boys. It is more common in towns than in the country, and affects the poor more than the well-to-do.

Want of proper food, neglect, ill usage, with the weakness and anæmia induced thereby, are common antecedents. The disease is intimately related to rheumatism, and serious attacks often follow rheumatic fever. In adult women pregnancy seems to increase liability. Worms, fright, and powerful emotions of all kinds are among possible causes. The malady seems to be due to changes in the *corpus striatum.*

Treatm. Rest, food, and aperients are the most useful remedies. Constipation, the presence of worms, and irregularities of menstruation should be first attended to. Iron in one form or another is very useful. Arsenic has proved, in the hands of some physicians, of great service.

Treatment for the Horse and other Animals. Similar to the above.

CHROMACOME. For dyeing the hair black. This is said to be prepared from harmless vegetable materials, but really consists of pyrogallic acid and nitrate of silver.

Chromacome. This is a French preparation which 'contains nothing injurious to health.' This hair-dye consists of two fluids. The first, 'Le chrômacome, teinture supérieure de William W. A. T., No. 1, Bonn,' weighing about 45 grms., is tincture of galls. The other, No. 2, is a solution of acetate of iron with a little nitrate of silver. When grey hair is moistened first with No. 1, then with No. 2, it becomes blackish-brown or black.

CHROMATE. *Syn.* Chromas, L. A salt in which the hydrogen of chromic acid, H_2CrO_4, is replaced by a metal or other basic radical. There are also *dichromates, trichromates,* and *titetrachromates,* which may be regarded as compounds of normal chromates with chromic anhydride CrO_3; *e.g.* potassium dichromate (usually called *bichromate*) $K_2Cr_2O_7$ may be regarded as a compound of K_2CrO_4 and CrO_3.

Chromates:

Prep. The starting-point in the manufacture of chromates is chrome iron-ore, $FeO.Cr_2O_3$, which is converted into potassium chromate by heating with potassium carbonate and lime. See Potassium Chromate.

The insoluble chromates, as those of barium, zinc, lead, mercury, silver, &c., may be made by mixing a soluble salt of those bases with neutral chromate of potassium. The first three are yellow, the fourth brick-red, and the fifth reddish-brown, or ruby-red when crystallised. The soluble chromates may all be made by direct solution of the base in the acid, or by double decomposition.

The most important *bichromate* is that of potassium (which *see*).

Prop., Uses, &c. The chromates are characterised by their yellow or red colour, the latter predominating when the acid is in excess; and except those with the alkaline bases, they are, for the most part, insoluble in water. Both the chromate and the bichromate of potassium are extensively used in dyeing and calico-printing. The former is employed in conjunction with sulphuric acid in the laboratory as an oxidising agent and in the manufactory for bleaching sperm oil. The bichromates of ammonium and potassium are used in photography.

They are readily recognised by the following tests:

On boiling a chromate with hydrochloric acid mixed with alcohol, chromic acid is first set free, and then decomposed, forming a green solution of chloride of chromium. Sulphuretted hydrogen and sulphurous acid effect similar changes. With acetate of lead the chromates give a yellow precipitate; with nitrate of silver, a reddish-brown; with nitrate of mercury, a red one. A small portion of a chromate imparts an emerald-green colour to a borax bead, if fused with it in the blowpipe flame.

CHROME ALUM. See Alums.

CHROME GREEN. See Green Pigments.

CHROME IRON-STONE. *Syn.* Chrome Iron-ore, $FeO.Cr_2O_3$. This, which is the principal ore of chromium, corresponds in composition to the magnetic oxide of iron; part of the iron, however, is generally displaced by the isomorphous metal magnesium, and part of the chromium by aluminium.

Chrome iron-stone is often met with in the form of octahedral crystals. Acids fail to dissolve it, and it cannot be fused in the furnace, but when heated it absorbs oxygen from the air. This oxidation may be effected very readily if the chrome ore, reduced to very fine powder, be mixed with a carbonate of one of the metals of the alkalies or alkaline earths, a chromate of the base being formed.

CHROME RED. See Red Pigments.

CHROME YELLOW. See Lead, Chromate of.

CHROMIC ACID. See Chromic Anhydride.

CHROMIUM. Cr. Atomic weight 52·45; melting-point above that of platinum. A metal discovered by Vauquelin in 1797. It is never found in the free state; its chief ore is chrome-ironstone, $FeO.Cr_2O_3$, which is found in some abundance in the Shetland Isles and elsewhere. It may be prepared by igniting the oxide, Cr_2O_3, with charcoal, at a white heat, in a lime crucible. Another method is to pass hydrogen and sodium vapour over chromic chloride, $CrCl_3$, heated to bright redness (*Frèmy*). Wöhler heats the chloride, $CrCl_3$, with sodium and potassium chlorides, and zinc. It may also be prepared by electrolysis of a solution of the chlorides. It is a greyish-white powder, only slightly oxidised on heating in air; it burns in chlorine gas; and dissolves in dilute hydrochloric acid with evolution of hydrogen.

CHROMOUS OXIDE. CrO. *Syn.* Protoxide of chromium. This oxide has not yet been obtained in a satisfactory manner, but the hydrate is prepared by the addition of potassium hydrate solution to a solution of chromous

chloride or sulphate. It forms a brownish-red powder, speedily passing to a deep foxy-red, with disengagement of hydrogen, it gives pale blue-coloured salts with the acids, which absorb oxygen with avidity, whilst the metal passes into a higher state of oxidation.

Chromic Anhydride. CrO_3. *Syn.* ANHYDROUS CHROMIC ACID, CHROMIC TRIOXIDE. *Prep.* By conducting gaseous fluoride of chromium into a silver or platinum vessel, the sides of which are just moistened with water, and the aperture covered with a piece of moist paper, the anhydride will be deposited under the form of red, acicular crystals, which will nearly fill the vessel. When the process is skilfully conducted, the product is of exquisite beauty and chemically pure. The fluoride referred to above is obtained from fluor spar, 3 parts; chromate of lead, 4 parts; fuming (or the strongest) sulphuric acid, 5 parts; mixed cautiously in a silver or leaden retort. A red-coloured gas is evolved, which acts rapidly on glass, forming fluosilicic acid gas, and upon water forming hydrofluoric acid and chromic anhydride. The moisture of the atmosphere is sufficient to effect the decomposition last referred to; the former substance escaping as gas, and the latter being deposited in small crystals.

It is also prepared nearly pure by adding a cold saturated solution of potassium bichromate to once and a half its bulk of pure strong sulphuric acid. As the liquor cools, the anhydrous chromic acid is deposited under the form of brilliant crimson-red prisms; the mother-liquor is then poured off, and the crystals, placed between two tiles of glass or porcelain, are submitted to strong pressure for some time, under a bell-glass or jar, when the anhydride will be found sufficiently dry. It may be deprived of a little adhering moisture by placing it over sulphuric acid for a short time *in vacuo*.

Commercially, it is prepared by the following process:

To a saturated solution of chromate of potassium, 100 parts, add oil of vitriol (sp. gr. 1·845), 49 parts; and let the whole cool. This is the common process. The product contains sulphate of potassium, but this does not much interfere with its value as a bleaching agent.

Prop., &c. Forms ruby-red anhydrous prisms, very soluble in water, with formation of true chromic acid, and extensively manufactured for the purpose of oxidising and bleaching substances. All chromium compounds form potassium chromate when ignited with potassium nitrate and potassium carbonate; when the residue is extracted with water, and acetate of lead added together with a little acetic acid, a yellow precipitate of lead chromate, $PbCrO_4$ is formed.

Chromic Oxide. Cr_2O_3. *Syn.* SESQUIOXIDE. Prepared by igniting potassium bichromate at a red heat and well washing the residue, and as hydrate by cautiously adding equal parts of hydrochloric acid and alcohol or sugar to a boiling solution of chromate of potash in water, in small portions at a time, until the red tint disappears, and the liquid assumes a green colour; pure ammonia in excess is next added, and the precipitate which subsides is collected and washed with water. Its reduction may also be easily effected by means of sulphurous acid.

Prop., &c. The anhydrous oxide is a rich crystalline green powder, insoluble in both water and acids; fused with borax and glass, it imparts to them a beautiful green colour. It is used in enamel-painting. The crystalline sesquioxide is used in the manufacture of razor-strops.

The hydrate is soluble in the acids and in alkaline lyes; with the first it forms salts which have a green or purple colour. Chromic sulphate combines with the sulphates of potassium and ammonium, giving rise to salts (CHROME ALUMS) which crystallise in magnificent octahedra of a deep claret colour. The finest crystals are obtained by very slow evaporation.

These salts of chromium are the most important, the chromous salts being seldom met with; they are best recognised by the following reactions:—Caustic alkalies precipitate the hydrate, easily soluble in excess of the precipitant. Ammonia the same, but the precipitate is nearly insoluble, especially in the presence of ammonium salts. The carbonates of potassium, sodium, and ammonium throw down a green precipitate of carbonate and hydrate, slightly soluble in a large excess. Sulphuretted hydrogen causes no change. Sulphydrate of ammonium precipitates the hydrate of a bluish-green colour.

Chromium Dioxide. CrO_2. A brown substance obtained by digesting chromic oxide, CrO_2, with excess of chromic acid, H_2CrO_4, or by partial reduction of chromic acid.

CHRYSENE, $C_{18}H_{12}$. A hydrocarbon found by Laurent in crude anthracene. It occurs in colourless glistening scales. It cannot be sublimed without decomposition. The crystals and chrysene solutions exhibit a deep reddish-violet fluorescence. Chrysene is very slightly soluble in cold alcohol, ether, benzene, and glacial acetic acid, but somewhat more soluble in carbon bisulphide. Its melting-point is from 248°—250° C., and it boils at a temperature above that which can be registered by the mercurial thermometer.

CHRYSOPHANIC ACID. See RHEIN.

CHYLE. The name given to the milky fluid generated during digestion, and absorbed from the intestines by a set of vessels called the *lacteals*, which carry it to the thoracic duct, whence it is immediately conveyed into the circulation.

CHYME. The pulpy mass formed by the food in its first great change, in the process of digestion in the stomach.

CIDER. *Syn.* CYDER; POMACEUM, L. Cider is the fermented juice of the apple, and is a very ancient beverage. Pliny calls cider and perry the 'wine of apples and pears.'

The attention of the cider farmer should be first directed to the culture of the apple tree. The situation most appropriate for an orchard is one on rising ground, rather dry than moist, and unexposed to sea air or high winds. The soil should be strong, but not too heavy, and should be rich in the alkaline and earthy bases, especially the phosphates. The selection of the proper varieties of the apple for grafting is also a point on which particular care should be taken. It is found that the juices of different kinds of apples vary in the quantity of saccharine matter which they contain,

as well as in other particulars that influence the quality and flavour of the cider prepared from them. As a general rule, those varieties should be chosen that yield a juice rich in sugar, and contain no undue amount of acid, and which, after the period of active fermentation is past, furnishes a liquor which clarifies itself and keeps well. This quality of the juice may generally be determined from its specific gravity. The heaviest and clearest is the best, other points being equal. The specific gravity of the juice of the different varieties of apple varies from 1·060 to 1·100.

Cider apples are classed under three heads—bitter, sweet, and sour. The first are the best; their juice has the greatest specific gravity, is the richest in sugar, ferments the most freely, clarifies spontaneously the quickest, and keeps the best after fermentation. They contain a minute quantity of extractive matter which is not present in other apples. The juice of sweet apples ferments tumultuously, clears with difficulty, and the resulting cider does not keep so well as that produced from the first variety. The juice of sour apples contains less sugar and more acid than the other two, and consequently not only produces the weakest, but the worst cider; it, however, 'fines' well, although it 'stores' badly. Sour and 'rough-tasted' apples are usually preferred by farmers for making cider. This preference, which is very decided in the West of England, may be readily accounted for. The sour and rough-tasted apples contain less sugar and more malic acid than some of the other varieties, and the presence of this acid impedes the conversion of the alcohol of the cider into vinegar; a change which their rude mode of operating renders otherwise inevitable. But cider made with such apples never equals in quality that prepared at a low temperature, from fruit abounding in sugar, provided equal skill is exercised in the manufacture as in the process of converting malt-worts into beer.

The process of making cider varies in different places, but in every case essentially consists of the collection of the fruit, the expression and fermentation of the juice, and the storing and management of the fermented liquor.

The collection of the fruit should not be commenced before it has become sufficiently mature, and should be performed with greater care than is commonly bestowed upon it. The apples, after being gathered, are usually left for 14 or 15 days in a barn or loft to mellow, during which time a considerable portion of the mucilage is decomposed, and alcohol and carbonic acid developed. If this 'ripening' is allowed to go too far, loss arises, notwithstanding the vulgar prejudice in its favour. The spoiled apples are then separated from the sound ones, as they not only impart a bad flavour to the cider, but impede its spontaneous clarification.

The expression of the juice is the next step in the process of cider-making. The apples are crushed or ground in mills consisting of two fluted cylinders of hard wood or cast-iron, working against each other. The common practice is next to sprinkle the pulp with 1-6th to 1-4th of its weight of spring- or river-water, and then to allow it to remain in tubs or wooden cisterns for 12 or 14 hours, during which time incipient fermentation commences, and the breaking up of the cells of the membrane takes place, by which the subsequent separation of the juice is facilitated. This plan, though general among cider manufacturers, is prejudicial to the quality of the future liquor; as not only is a portion of the newly formed alcohol lost, but the skins and pips often impart to it a disagreeable flavour. By employing more efficient crushing machinery this system of vatting is rendered quite unnecessary. A machine furnished with a revolving circular rasp, similar to that used in making potato-starch, is admirably adapted for this purpose.

The pulp of the crushed or ground apples is now placed on a kind of wicker frame, or in hair-cloth or coarse canvas bags, and after being allowed to drain into suitable tubs or receivers, is subjected to powerful pressure, gradually applied, in the cider press. The liquor which runs off first is the best, and is usually kept separately; whilst that which follows, especially the portion obtained by much pressure, tastes of the pips and skins.

The expressed juice or 'must,' obtained as above, is next put into clean casks with large bung-holes, and freely exposed to the air and the shade, where they are placed on 'stillions,' with flat tubs under them to catch the waste. They are now constantly attended to and kept quite full, in order that the yeast, as it forms, may froth over and be carried off from the surface of the liquor. After 2 or 3 days for weak cider, and 8 or 10 days for strong cider, or as soon as the sediment has subsided, the liquor is 'racked off' into clean casks, which have been (according to the common practice) previously sulphured with a cooper's match. The casks containing the 'racked cider' are then stored in a cellar, shaded barn, or other cool place, where a low and regular temperature can be ensured, and are left to mature or ripen. By the following spring the cider is commonly fit for use, and may be 're-racked' for sale.

The marc, or pressed pulp, is generally again sprinkled with $\frac{1}{3}$ or $\frac{1}{2}$ its weight of water, and re-pressed. The resulting liquor, when fermented, forms a weak kind of cider (cider moil, water moil), which is reserved for domestic use in the same way as table-beer. The refuse-pulp (apple-marc, pomace, pommage, apple cheese) is used as food for pigs and store cattle, and is very acceptable to them.

The storing and management of cider are matters of vast importance to the cider farmer, the factor, the wholesale dealer, and the bottler. The principles by which these should be directed are precisely similar to those which are explained under the heads Brewing, Fermentation, and Malt Liquors; and which, indeed, refer, with slight modifications, to all fermented liquors.

Preparatory to bottling cider it should be examined, to see whether it is clear and sparkling. If not so, it should be clarified in a similar way to beer, and left for a fortnight. The night before it is intended to put it into bottles the bung should be taken out of the cask, and left so until the next day, and the filled bottles should not be corked down until the day after; as, if this is

done at once, many of the bottles will burst by keeping. The best corks should alone be used. Champagne bottles are the variety generally chosen for cider. It is usual to wire down the corks, and to cover them with tinfoil, after the manner of champagne. A few bottles at a time may be kept in a warm place to ripen. When the cider is wanted for immediate use, or for consumption during the cooler portion of the year, a small piece of lump sugar may be put into each bottle before corking it; or, what is the same thing in effect, the bottles may be corked within 2 or 3 hours after being filled. In summer, and for long keeping, this practice is, however, inadmissible. The bottled stock should be stored in a cool cellar, when the quality will be greatly improved by age. Cider for bottling should be of good quality, sound and piquant, and at least a twelvemonth old. When out of condition it is unfit for botttling.

Qual., &c. Cider, when of good quality, and in good condition, is doubtless a very wholesome liquor. Cider consumers, living in the cider districts, appear to enjoy almost an immunity from cholera, and often from other diseases which are common in other parts of the kingdom. At the same time, however, it is right to mention that the dry colic or belly-ache (*Colica pictorum*) is far from uncommon in these districts, but is wholly confined to those who drink early, hard, or inferior cider, made from harsh, unripe fruit. We believe that, in most cases, it may be referred to the acid of the common cider having acted on the lead, pewter, or copper of the articles or utensils with which it has come in contact, and of which it has dissolved a very minute portion. The best cider contains from 8% to 10% of absolute alcohol: ordinary cider from 4% to 6%.

Concluding Remarks. Much of the excellence of cider depends upon the temperature at which the fermentation is conducted; a point utterly overlooked by the manufacturers of this liquor. Instead of the apple-juice, as soon as it is expressed from the fruit, being placed in a cool situation, where the temperature should not exceed 50° or 52° F., it is frequently left exposed to the full heat of autumn. In this way much of the alcohol formed by the decomposition of the sugar is converted into vinegar by the absorption of atmospheric oxygen, and thus the liquor acquires that peculiar and unwholesome acidity known in the cider districts by the name of 'roughness.' When, on the contrary, the fermentation is conducted at a low temperature, nearly the whole of the sugar is converted into alcohol, and this remains in the liquor, instead of undergoing the process of acetification. The acetous fermentation, by which alcohol is converted into vinegar, proceeds most rapidly at a temperature of about 90° F., and at lower temperatures the action becomes gradually slower, until at 46°—50° F. no such change takes place (*Liebig*). It is therefore evident that if the saccharine juice of apples, or any other fruit, is made to undergo the vinous fermentation in a cool situation, less of the spirit resulting from the transformation of the sugar will be converted into acetic acid, and, consequently, more will be retained in an unaltered state in the liquor, to improve its quality, and by its conservative and chemical action to preserve it from future change. This is the principal cause, other circumstances being alike, of the difference in the quality of the cider made by persons living in the same district. The one has probably a cooler barn and cellar than the other to store his liquor in, and is more careful to keep the pulp and juice cool during the early part of the process. In Devonshire the pressing and fermentation are conducted in situations where the temperature varies little from that of the external air, and fluctuates with all its changes; the result is that Devonshire cider, of the best class, will rarely keep more than 4 or 5 years, and seldom improves after the second or third year; whilst the cider of Herefordshire and Worcestershire, where these operations are more carefully attended to, will keep for 20 or 30 years.

When the pressing the apples for the juice is deferred until late in the season, it sometimes happens that the fermentation is sluggish. Though the juice has been set on the old system in November or December, the working hardly commences until March. At this time the cider is sweet; it now rapidly becomes pungent and vinous, and is soon ready to be racked for use. If the fermentation still continues, it is again racked into a clean cask that has been sulphured; or 2 or 3 cans of the cider put into a cask, and a brimstone-match burned in it. The cask is then agitated, after which it is nearly filled with the cider. By this process the fermentation is checked, and the cider in a short time becomes fine. Great care must be taken that the sulphuring be not overdone, as it is apt to impart a slightly unpleasant flavour to the liquor. If, on the first operation, the fermentation is not checked, the process of 'racking' is repeated, until the liquor becomes clear, and is continued from time to time, till the cider is in a quiet state, and fit for drinking.

A common practice in Devonshire is to add a stuff called 'stum,' sold by the wine-coopers, or an article called 'antiferment,' sold by the druggists, for the purpose of checking the fermentation, but a much better plan is that described above.

To improve the flavour of weak cider, or to render ordinary cider more vinous, various plans are followed by the cellarmen and bottlers. An excellent one is to add to each hogshead 1½ gall. of good brandy or rum, with 2 oz. of powdered catechu (dissolved in water), 10 lbs. of good moist sugar or honey, ½ oz. each of bitter almonds and cloves, and 4 oz. of mustard seed (all in powder). These must be well 'rummaged' into the liquor, and the whole occasionally stirred up for a fortnight, after which it must be allowed to repose for 3 or 4 months, when it usually will be found perfectly 'bright,' and no bad substitute for foreign wine. Should this not be the case, the liquor must be 'fined' with a pint of isinglass finings, or a dozen eggs, and allowed to rest for a fortnight. If the cider is preferred pale, the catechu must be omitted, and instead of isinglass a quart of skimmed milk is to be used as 'finings.' When desired of a pinkish tint, 1 oz. of cochineal (in powder) may be added instead of the catechu.

About 13 cwt. of November apples commonly yield 1 hogshead of cider. In Devonshire about 6 sacks, or 24 bushels are the common quantity for the hogshead of 63 galls.

The best cider made at the present day is that of Normandy, Herefordshire, and New Jersey (U.S.), and next that of Devonshire and Somersetshire. See ANTIFERMENT, FERMENTATION, &c.

Cider, Champagne. This name is given in the United States of America to a fine, pale variety of cider, much used for bottling, which has a great resemblance to inferior champagne. The best variety comes from New Jersey. The name is also applied in this country in a similar manner. The following is a good form for a 'made' cider of this class:

Prep. Good pale vinous cider, 1 hhd.; proof spirit (pale), 3 galls.; honey or sugar, 14 lbs.; mix well, and let them remain together in a temperate situation for 1 month; then add orange-flower water, 3 pints; and in a few days fine it down with skimmed milk, $\frac{1}{2}$ gall. A similar article, bottled in champagne bottles, silvered, and labelled, is often sold to the ignorant for champagne.

Cider, Made. An article under this name is made in Devonshire, chiefly for the supply of the London market, it having been found that the ordinary cider will not stand a voyage to the metropolis without some preparation. The finest quality of 'made' cider is simply ordinary cider racked into clean and well-sulphured casks; but the mass of that which is sent to London is mixed with water, treacle, and alum. The cider sold in London under the name of Devonshire cider would be rejected even by the farmers' servants in that county.

Cider, Raisin. This is made in a similar way to raisin wine, but without employing sugar, and with only 2 lbs. of raisins to the gall., or even more, of water. It is usually fit for bottling in 10 days, and in a week longer is ready for use.

CIDER SPIRIT. See BRANDY.

CIGAR. *Syn.* SEGAR; CIGARRE, Fr.; CIGARRO, Span. A small roll of tobacco-leaf used for smoking. The leaf is stalked or stripped of its mid-rib, and damped before it passes into the hands of the cigar-roller. The envelope or skin is cut from a smooth, unbroken leaf, and is rolled round sufficient tobacco to form the inside. To secure the loose end of the envelope a small quantity of paste, coloured brown with chicory, is generally used. Only those who have had great practice can make cigars of a good shape. A full account of the manufacture of cigars does not come within the scope of this work. Although cigars of British make cannot compete in point of flavour with those manufactured in tobacco-growing countries, they have obtained a high degree of favour from the excellent manner in which they are made, and from their comparative cheapness. For information respecting the adulteration of cigars, and the influence of their use upon health, see TOBACCO.

CIGARS. (In *pharmacy.*) *Syn.* MEDI'CATED CIGARS, M. CIGARETTES'. The administration of medicinal agents in the form of cigars is of recent introduction, and as yet in only very limited use. The medicinal substance, if of a suitable description, as the leaves of plants, is made up into small rolls, like cheroots, and then smoked in the usual manner. In some cases, common cigars, or paper cigars (cigarettes), are medicated by moistening them in a preparation of the article to be administered. When the narcotic property of the tobacco would prove injurious, it is first exhausted by soaking and washing it in water.

Cigars, Anti-Asthmatic. *Syn.* ANTI-ASTHMATIC CIGARETTES. (*Vaquelius.*) Take sodium arseniate, 3 gr.; extract of belladonna, 8 gr.; extract of stramonium, 8 gr. Mix and dissolve in a small quantity of water, then soak up the mixture with fine white blotting-paper, dry the paper and cut into 24 equal parts. Each part is rolled inside a piece of cigarette paper.

Cigars, Aromatic. *Syn.* AROMATIC CIGARETTES; CIGARETT'Æ AROMAT'ICÆ, L.; CIGARETTES AROMATIQUES, Fr. Aromatic spices, lavender flowers, &c., made into cigarettes. Smoked for their odour; and in tooth-ache, face-ache, &c. See CIGARS, SCENTED.

Cigars, Arsenical. *Syn.* CIGARR'Æ ARSENICALES, L. *Prep.* Dissolve arseniate of soda, 1 part, in water, 30 parts; dip white, unsized paper into the solution, and form it into small rolls, 3 or 4 inches long. Used in pulmonary consumption; 4 or 5 whiffs as many times a day.

Cigars, Balsamic. *Syn.* BALSAMIC CIGARETTES; CIGARR'Æ BALSAMICÆ, CIGARETTÆ B., L. Thick, unsized paper is soaked in a solution of saltpetre and dried; after which it is brushed over first with tincture of cascarilla, and, when again nearly dry, with compound tincture of benzoin; in about half an hour it is cut into pieces ($1\frac{1}{2} \times 4$ inches), and rolled into cigarettes. Used in hoarseness, loss of voice, asthma, &c.

Cigars, Belladonna. *Syn.* BELLADONNA CIGARETTES; CIGARETT'Æ BELLADONNÆ, L. *Prep.* 1. Belladonna leaves made into cigarettes of 1 dr. each.

2. (Compound—C. B. COMPOS'ITUM.) From Belladonna leaves, 4 parts; moistened with tincture of opium (Ph. L.), 1 part; dried and made into 1-dr. cigarettes, as before.

Used as an anodyne and antispasmodic, in troublesome coughs, hooping-cough, toothache, sore throat, tic douloureux, &c.

Cigars, Camphor. (*Raspail*, Paris.) A remedy for various chest diseases, such as catarrh, hoarseness, loss of voice, spasms, hooping-cough, phthisis; also, if the saliva be swallowed, for heartburn, pains in the stomach, as gastritis. They consist either of a straw or quill filled with broken camphor, or of a bone or horn mouthpiece, furnished at the outer end with a little capsule for the camphor (*Wittstein*).

Cigars, Camphor. *Syn.* CAMPHOR CIGARETTES; CIGARETT'Æ CAMPHO'RÆ, L.; CIGARETTES DE CAMPHRE, Fr. *Prep.* 1. Bibulous paper, moistened with 2 or 3 drops of essence of camphor, and rolled into cigarettes. For use they are loosely placed in a tubular cigar-holder.

2. (*Raspail.*) These are made by loosely filling a quill or large straw with small fragments of camphor, closing the open end with a little cotton wool or bibulous paper, and piercing the closed end with a pin, to allow the passage of air.

Obs. Both the above are used unlighted by drawing the air through them into the mouth, which then becomes very slightly charged with the vapour of camphor. In cold weather the vaporisation is prompted by holding the cigarette for a few minutes in the warm hand. The homœopathists regard them as prophylactic of cholera, and the common people hold them to possess the same virtue in reference to contagious diseases generally, but especially typhus and scarlet fever. They should not be employed oftener than 3 or 4 times a day.

Cigar Flavours. 1. Fluid extract of valerian, 1 oz.; tincture of tonquin bean, 8 oz.; alcohol to make 32 oz.

2. Valerianic acid, 3 dr.; butyric ether, 10 minims; acetic ether, 40 minims; alcohol, 64 oz.

3. Tincture of valerian, 4 dr.; butyric ether, 4 dr.; tincture of vanilla, 2 dr.; spirit of nitrous ether, 1 dr.; alcohol, 5 oz.; water to make 16 oz.

Cigars, Henbane. *Syn.* CIGARR'Æ HYOSCY'AMI, L. From henbane leaves, as directed under BELLADONNA CIGARS.

Cigars, Indian Hemp. The flowering tops made into cigarettes, which are used in asthma. They must be used with caution.

Cigars, Mercu''rial. *Syn.* CIGARR'Æ MERCURIALES, L. *Prep.* (*Paul Bernard.*) Ordinary cigars are deprived of their narcotic properties by soaking them in water, and are then wetted with a weak solution of corrosive sublimate to which a little opium is generally added. The proportion may be, of corrosive sublimate, 1 gr.; rectified spirit, 20 drops; dissolve; add laudanum, 15 drops; with this solution 6 cigars are to be equally moistened to within about $1\frac{1}{2}$ inch of the mouth end, and then set aside to dry.

Used by persons afflicted with syphilitic affections of the throat and palate, as a convenient method of mercurial fumigation. For those accustomed to the use of tobacco, mild cigars, undeprived of their nicotine, may be employed for the purpose.

Cigars, Scent'ed. *Syn.* PERFU''MED CIGARS; CIGARR'Æ AROMAT'ICÆ, L. *Prep.* 1. By moistening ordinary cigars with a strong tincture of cascarilla, to which a little gum-benzoin and storax may be added. Some persons add a small quantity of camphor, or of oil of cloves or cassia.

2. By soaking the tobacco of which the cigars are to be made, or the cigars themselves, for a short time in a very strong infusion of cascarilla, and then allowing them to dry by a very gentle heat.

3. By simply inserting very small shreds of cascarilla bark between the leaves of the cigar or in small slits made for the purpose.

Obs. The above yield a very agreeable odour when smoked; but are said to intoxicate quicker than unprepared cigars of equal strength and quality. They lose much of their fragrance by age.

Cigars, Stramo'nium. *Syn.* DATU'RA CIGARS; CIGARR'Æ STRAMO''NII, L. From the leaves of *Datura stramonium*, or preferably those of the Eastern species, *Datura fatula.* See ASTHMA, DATURA.

CINCHONA BARKS. *Syn.* CINCHONÆ CORTEX; PERUVIAN BARK; JESUIT'S BARK. The native names are *quinquino* and *quina quina.* Of the nearly 40 different known species of cinchona trees, the barks of about a third are employed, some directly in medicine, but by far the larger number as sources of quinine and the other cinchona alkaloids. The original habitat of the genus *Cinchona* is the Andes, where it is found at a height of between 3000 and 12,000 feet above the sea, growing mostly in patches, distributed amongst the palms, plantains, and other tropical trees that form the vast forests, for the most part clothing the eastern slopes of the Cordilleras, and extending from 10° north to about 19° south latitude. In this district there is always an abundance of moisture and a mean temperature of about 62° F. In 1853 the Dutch Government introduced the cinchona into Java, and in 1861 the East Indian Government, following their example, introduced it into British India, where it is now acclimatised, large plantations of it growing on the Neilgherries and in the valleys of the Himalayas. The cinchona is now also successfully cultivated in Ceylon and Jamaica.

The method followed in the collection of the bark by the Peruvians is a very wasteful and destructive one, and consists either in stripping the bark from the trees when they have attained a sufficient age, or in felling the tree a little above the roots. If the latter method be adopted, the roots give out a growth of suckers, which yield a good bark. The bark is never removed during the rainy season.

Previous to being stripped off, the bark is sometimes cleaned with a brush, and then peeled off in pieces varying from 15 to 18 inches long, and from 4 or 5 in width. The thinnest pieces, which are derived from the branches or the trunks of small trees, are dried in the sun, and thus acquire the well-known quill-like form. The larger trunks yield the flat specimens, which are submitted to a kind of pressure as they are being dried. The inferior specimens being rejected, the dried barks (mostly of the same kind) are sewed in canvas, and thus conveyed to the nearest depôt, from whence, previous to being shipped, they are enclosed in another envelope of fresh hide, the package being then known under the name of a *seron.*

Structure of Cinchona Barks.—A few general observations on the structure of the bark of cinchona will be appropriate here. The epidermis is only found on the youngest bark before it has attained sufficient age for medicinal use; it is then replaced by the corky layer. In most species this cracks, and is easily separable, but in some it is firmly attached to the internal layers. These are composed of the middle layer of the bark or mesophlæum, formed of parenchyma, and the innermost layer endophlæum, or liber. The middle layer disappears in some barks, which are thus wholly composed of liber. This is a means of distinguishing them. The liber is traversed by medullary rays, which project into the mesophlæum. It is, therefore, composed of woody fibres (prosenchyma) and soft parenchyma.

The arrangement of the woody fibres, their

colour, size, and shape, give a special character to the cinchona barks.

As compared with other barks, the fibres of the liber are shorter and more loosely arranged, being for the most part separate or united into very short bundles. The fibres, therefore, are easily isolated; they are spindle-shaped, subquadrangular, rarely exceeding 1-10th of an inch in length, usually straight, and are very brittle, the cavity of the cell of which each is composed being reduced by secondary deposits to a fine canaliculus. This short and loose fibrous structure is not found in other barks.

In some cinchona bark a system of lactiferous vessels is found between the liber and mesophlæum (*Royle*).

The parenchyma of the barks abounds in starch and oxalate of lime, or else contains a soft brown deposit.

The British Pharmacopœia divides the cinchona barks into the three classes of—

1. Yellow Cinchona Bark. *Syn.* Cinchona flavæ cortex. The *Cinchona calisaya* of Weddell.

2. Pale Cinchona Bark. *Syn.* Cinchonæ pallidæ cortex. The bark of *Cinchona officinalis*, Linn.; var. *Condaminea* of Hooker. This bark is also known under the name of *Crown-bark*, from its having formerly been used by the royal family of Spain.

3. Red Cinchona Bark. *Syn.* Cinchonæ rubræ cortex. The *Cinchona succirubra* of Pavon.

4. Columbian Bark. *Syn.* Carthagena bark. The bark of *Cinchona lancifolia* (*Mutis*.)

5. In addition salts of quinine and cinchonine may be obtained from some species of Remijia, D. C.

The therapeutic properties of the cinchona barks are due to the following alkaloids:

Quinia, or quinine, having the composition $C_{20}H_{24}N_2O_2$.

Quinidia, or quinidine, having the composition $C_{20}H_{24}N_2O_2$.

Cinchonia, or cinchonine, having the composition $C_{20}H_{24}N_2O$.

Cinchonidia, or cinchonidine, having the composition $C_{20}H_{24}N_2O$.

Quinamina, or quinamine, having the composition $C_{20}H_{24}N_2O_2$.

Besides the above, an alkaloid, which has been named *Paracina*, has been obtained from the bark of the *Cinchona succirubra;* whilst in those barks which contain only small portions of the more active constituents above named there have been found two alkaloids, named respectively *Aricina* and *Cusconia*, which have lately been accurately investigated by Hesse, who has determined their chemical constitution (Liebig's Annalen and Berichte der Chemischen Gesselschaft in Berlin).

The cinchona barks vary greatly in the amount of alkaloids they contain and in their proportion to each other, these being dependent upon the species of varieties and many other circumstances. Of the alkaloids, quinine and cinchonine were till lately the most abundant, but since the introduction of cinchonine cultivation into India, cinchonidia has been found in very large quantity. Royle says: "Good Calisaya bark usually contains from 5% to 6% of quinia," but actually South American calisaya containing such an amount of quinia is rare in the market. Some barks, however, derived from cinchonas cultivated in India, such as *C. calisaya*, var. *Ledgeriona*, and some varieties of *C. officinalis*, yield even a still higher percentage of quinine.

The South American crown, or loxa bark, is very variable, and contains chiefly cinchonine.

Red bark also varies considerably, yielding from 3% to 10% of alkaloids, of which quinia forms only a small fraction, whilst generally cinchonidine is predominant. The development of the alkaloids is greatly influenced by cultivation, but particularly by the 'renewing process,' which, applied to the *C. succirubra*, trebles the amount of quinine in the bark.

In addition to the alkaloids already mentioned, the cinchona barks contain the following acid principles: Kinic acid, Cincho-tannic acid, and Quinovic or Chinovic acid. The quinovic acid is accompanied by an amorphous bitter substance, named Chinovin or Quinovia, which is present in much greater proportion than the acid, of which generally there are only traces. A description of these bodies will be found by referring to them under their respective names. Cinchona-red is another amorphous substance which is the body to which the red hue of the cinchona barks is due. It is produced when cincho-tannic acid is boiled with dilute sulphuric acid, sugar being formed at the same time. When fused with potash, proto-catechinic acid is formed. Cinchona-red dissolves sparingly in alcohol, freely in alkaline solutions, but neither in water nor ether. Thick red bark contains it to the amount of more than 10%.

Cinchona red is the product of the oxidation of cincho-tannic acid, and is contained largely in South American red bark, because this is the product of old trees; but sparingly in Indian red bark, because this is always collected from trees not more than fourteen years old.

Medicinal Properties of the Cinchona Barks. The therapeutic effects of the cinchona barks are doubtless due to the alkaloids they contain; but in spite of their variability of the composition in this respect, which has been shown to be very great, they are very extensively employed in medical practice in the forms of powder, decoction, tincture, and extract.

Dr de Vrij, the eminent quinologist, is of opinion that the therapeutic effects of bark are chiefly due in part to the alkaloids, and in part to the cincho-tannic acid they contain, and as red Indian bark is rich in both these constituents, he considers it the best suited for medical practice. See Quinetum.

Garrod says: "Given in small doses, bark causes an increase of appetite, especially in weak patients, and at the same time improves the condition of the muscular system; hence the improvement of the blood and general health. It may, therefore, be well designated a tonic.

"Its power in bracing up the system is also seen in the check given to the colliquative sweating occurring in extreme debility. The pulse is not quickened by the use even of large doses of

The following Prospectus of the Principal Species of Cinchona is from FLÜCKIGER *and* HANBURY'S '*Pharmacographia.*'

Species (excluding Sub-species and Varieties) according to Weddell.	Where figured.	Native Country.	Where cultivated.	Product.
I. STIRPS CINCHONÆ OFFICINALIS—				
1. Cinchona officinalis, Hook	'Bot. Mag.,' 5364	Ecuador Loxe	India, Ceylon, Java	Loxa, or Crown Bark, Pale Bark.
2. ,, macrocalyx, Pav.	Howard, 'N. Q.'	Peru	....	Ashy Crown Bark. The sub-species *C. Palton* affords an important sort called *Palton Bark*, much used in the manufacture of quinine.
3. ,, lucumæfolia, Pav.	,,	Ecuador, Peru	....	Carthagena Bark, confounded with Palton Bark, but is not so good.
4. ,, lanceolata, R. and P.	,,	Peru	....	Columbian Bark. Imported in immense quantities for manufacture of quinine. The soft Columbian Bark is produced by Howard's var. *oblonga*.
5. ,, lancifolia, Mutis	Karst., tab. 11, 12	New Granada	India	
6. ,, amygdalifolia, Wedd.	Wedd., tab. 6	Peru, Bolivia	....	A poor bark, not now imported.
II. STIRPS CINCHONÆ RUGOSÆ—				
7. Cinchona Pitayensis, Wedd.	Karst, tab. 22 (G.), Trianæ	New Granada, Popayan	India	Pitayo Bark. Very valuable; used by makers of quinine. It is the chief source of quinidine.
8. ,, rugosa, Pav.	Howard, 'N. Q.'	Peru	....	Bark unknown, probably valueless.
9. ,, Mutisii, Lamb.	,,	Ecuador	....	Bark, not in commerce, contains only aricine.
10. ,, hirsuta, R. and P.	Wedd., tab. 21	Peru	....	....
11. ,, Carabayensis, Wedd.	Wedd., tab. 19	Peru, Bolivia	....	Bark, not collected.
12. ,, pahudiana, How.	Howard, 'N. Q.'	Peru	India, Java	A poor bark, yet of handsome appearance; propagation of tree discontinued.
13. ,, asperfolia, Wedd.	Wedd., tab. 20	Bolivia	....	Bark, not collected.
14. ,, umbellulifera, Pav.	Howard, 'N. Q.'	Peru	....	Bark, not known as a distinct sort.
15. ,, glandulifera, R. and P.	,,	Peru	....	,, ,,
16. ,, Humboldtiana, Lamb.	,,	Peru	....	False Loxa Bark, Jaen Bark. A very bad bark.
III. STIRPS CINCHONÆ MICRANTHÆ—				
17. Cinchona Australis, Wedd.	Wedd., tab. 8	South Bolivia	....	An inferior bark, mixed with Calisaya.
18. ,, scrobiculata, H. and B.	,,	Peru	....	Bark, formerly known as *Red Cusco Bark* or *Santa Anna Bark*.
19. ,, Peruviana, How.	Howard, 'N. Q.'	Peru	India	Grey Bark, Huanuco, or Lima bark. Chiefly consumed on the continent.
20. ,, nitida, R. and P.	,,	Peru	India	
21. ,, micrantha, R. and P.	,,	Peru	India	
IV. STIRPS CINCHONÆ CALISAYÆ—				
22. Cinchona Calisaya, Wedd.	Wedd., tab. 9	Peru, Bolivia	India, Ceylon, Java, Jamaica, Mexico	Calisaya Bark, Bolivian Bark, Yellow Bark. The tree exists under many varieties; bark also very variable.
23. ,, elliptica, Wedd.	,,	Peru, Carabaya	....	Carabaya Bark. Bark scarcely now imported. *C. cuneura*, Miq. (flower and fruit unknown), may perhaps be this species.
V. STIRPS CINCHONÆ OVATÆ—				
24. Cinchona purpurea, R. and P.	Howard, 'N. Q.'	Peru, Huamalies	....	Huamalies Bark, not now imported.
25. ,, rufinervis, Wedd.	,,	Peru, Bolivia	....	Bark, a kind of light Calisaya.
26. ,, succirubra, Pav.	....	Ecuador	India, Ceylon, Java, Jamaica	Red Bark, largely cultivated in British India.
27. ,, ovata, R. and P.	,,	Peru, Bolivia	India (?), Java (?)	Inferior brown and grey barks.
28. ,, cordifolia, Mutis	Karst., tab. 8	New Granada, Peru	....	Columbian Bark (in part). Tree exists under many varieties; bark of some used in manufacture of quinine.
29. ,, Tucujensis, Karst.	Karst., tab. 9	Venezuela	....	Maracaibo Bark.
30. ,, pubescens, Vahl.	Wedd., tab. 16	Ecuador, Peru, Bolivia	....	Areca Bark (Cusco Bark from var. *Pelletieriana*). Some of the varieties contain aricine. *C. caloptera*, Miq., is probably a variety of the species.
31. ,, purpurascens, Wedd.	Wedd., tab. 18	Bolivia	....	Bark, unknown in commerce.

quinine, although it is frequently made stronger, nor does bark itself, in the majority of cases increase the heart's action.

"Bark also produces a peculiar influence upon the nervous system, which is exhibited in the extraordinary power it possesses of arresting the progress of certain diseases characterised by a periodical recurrence of their symptoms as ague, the different forms of neuralgia, and certain inflammatory affections; how this effect is produced is at present unknown. Bark acts likewise as an astringent, and this property, combined with the tonic and anti-periodic powers, is often of much therapeutic value."

For the method of estimating the alkaloids in cinchona bark, see QUINOMETRY, QUININE, QUINIDINE, QUINOIDINE, QUINICONE, QUINAMINE, CINCHONINE; also the different pharmaceutical preparations of CINCHONA BARK.

CINCHONA FEBRIFUGE. A white powder made and sold by the Indian Government, the average composition of which is 15·5 quinine, 33·5 cinchonine, 29 cinchonidine, 17 amorphous alkaloid, 5 colouring matter.

CINCHONIDINE. *Syn.* CINCHONIDINA. $C_{20}H_{24}N_2O$. This cinchona alkaloid is isomeric with cinchonine. It occurs in large, shining striated rhombic prisms, which are anhydrous. It dissolves in ·76 parts of ether and 20 of spirit of wine. The solutions are only slightly fluorescent, but do not answer to the chlorine and ammonia tests.

"The great powers and activity of this alkaloid have only of late been appreciated. As a protoplasm-poison, and probably in every other physiological action, it comes next to quinine and quinidine, and decidedly above cinchonin" (*Dr C. D. Phillips*).

If it is chemically pure, cinchonidine belongs to the non-fluorescent alkaloids.

CINCHONIDINÆ SULPHAS. *Syn.* SULPHATE OF CINCHONIDINE $(C_{20}H_{24}N_2O)_2H_2SO_4,3H_2O$. This sulphate may be obtained from the mother-liquors of the crystallisation of sulphate of quinine, by concentration, purified by crystallisation from alcohol and finally from hot water. Colourless silky crystals, usually acicular, soluble in 150 parts of cold water and in 60 of rectified spirit.

CINCHONINE. *Syn.* CINCHONINA. $C_{20}H_{24}N_2O$. This alkaloid abounds most in the paler varieties of the cinchona barks. It occurs in clear, colourless, 4-sided prisms, which are soluble in 30 parts of water, and in about 400 parts of ether, and 120 of spirits of wine. With acids it forms soluble salts, which do not fluoresce in solution, and are turned lightish brown-yellow by the chlorine and ammonia tests. Of its salts, the hydriodate is readily soluble in water, and still more so in alcohol, whether dilute or strong. Cinchonine may be prepared from its sulphate or disulphate in the same way as quinine.

Cinchonine, Sulphate of. *Syn.* CINCHONIÆ SULPHAS. Take of the mother-water remaining after the crystallisation of sulphate of quinine in the process for preparing that salt a convenient quantity, solution of soda, alcohol, diluted sulphuric acid, animal charcoal in fine powder, each a sufficient quantity. To the mother-water add gradually with constant stirring solution of soda, until the liquid becomes alkaline. Collect on a filter the precipitate formed, wash it with water, and dry it. Then wash it with successive small portions of alcohol to remove other alkaloids which may be present, mix the residue with 8 times its weight of water, and, having heated the mixture, add gradually diluted sulphuric acid until it is neutralised and becomes clear. Then boil the liquid with animal charcoal, filter it while hot, and set it aside to crystallise. Lastly, drain the crystals and dry them on bibulous paper. By evaporating the mother-liquid more crystals may be obtained.

Hard, short, prismatic crystals, soluble in 70 parts of cold water and 9 of rectified spirit.

CINCHO-TANNIC ACID. This acid is precipitated from a decoction of bark by acetate of lead, after the decoction has been freed from cinchona-red by means of magnesia.

If the cincho-tannate of lead thus formed be decomposed by sulphuretted hydrogen, and the solution carefully evaporated *in vacuo*, the acid may be obtained as an amorphous, hygroscopic substance, readily soluble in water. A ferric salt added to a solution of this acid imparts a greenish colour to it.

Cincho-tannic acid is very soluble in water, but not in acids. Therefore a concentrated watery infusion (1 to 4) of Indian bark gives a precipitate upon the addition of strong hydrochloric acid. By this means a rough estimation may be formed of the amount of cincho-tannic acid in a sample of bark.

CINNABAR. *Syn.* NATIVE VERMILLION. This compound, which is one of the most abundant of the ores of mercury, is a product of considerable importance in the arts, and some portion of it are sometimes sufficiently pure in colour to be used after mere levigation. Generally, however, the factitious kind is employed. See VERMILLION.

CINNAMEÏN. *Syn.* OIL OF BALSAM OF PERU. The benzyl ether of cinnamic acid. It is a volatile oil found in balsam of Peru.

CINNAMIC ACID. $C_6H_5.CH; CH.CO_2H$. *Syn.* PHENYL-ACRYLIC ACID; BENYLIDENE ACETIC ACID. A colourless, transparent, crystalline substance, obtained from oil of cinnamon liquid, storax, balsam of Peru, balsam of Tolu, and the gum-benzoin. It may be prepared systematically from benzoic aldehyde, and some acetyl compound. Melting-point 133° C. (271° F.); sublimes at 300° C. (572° F.). Distilled with potassium bichromate and sulphuric acid, it is converted into benzoic acid. It is freely dissolved by alcohol, but is nearly insoluble in water. Its salts are called cinnamates.

CINNAMON. *Syn.* CINNAMON BARK; CINNAMOMI CORTEX (B. P.), L. The inner bark of shoots from the truncated stock of the *Cinnamomum zeylanicum*, imported from Ceylon, and distinguished in commerce as Ceylon cinnamon. The best is obtained from branches about 3 years old.

Used in *medicine* as a carminative and astringent, chiefly as an adjuvant to other medicines, *e.g.* with chalk, in diarrhœa. *Dose,* 10 to 20 grs.

Obs. Owing to the high price of this drug it has become a general practice to substitute the bark of cassia (*Cassia; Cortex cinnamomi cassia*) for it, which so closely resembles it in flavour that the uninitiated regard them as the same. Cassia, however, is not only thicker and coarser than cinnamon, but its fracture is short and resinous, and its flavour is more biting and hot, whilst it lacks the peculiar sweetish taste of cinnamon. The thickness of cinnamon seldom exceeds that of good drawing paper.

CISTERNS. See TANKS.

CITRATE. A salt in which part of the hydrogen of citric acid is replaced by a metal or basic radical. There are 3 series of citrates, since citric acid is tribasic. The alkaline salts are soluble, those of zinc, iron, cobalt, and nickel less so; most others are insoluble. Iron, manganese, and aluminium are not precipitated by alkalies, in presence of citrates. It should be mentioned that the so-called 'citrate of magnesia' of the shops is simply a mixture of tartaric acid and sodium carbonate.

CITRIC ACID. $H_3C_6H_5O_7,H_2O$. *Syn.* ACID OF LEMONS; AC'IDUM LIMO'NIS, ACIDUM CIT'RICUM (B. P.), L.; ACIDE CITRIQUE, Fr.; CITRONENSAÜRE, Ger. An acid peculiar to the vegetable kingdom. It is obtained in large quantity from the juice of lemons and other fruits of the genus *Citrus;* it is also found in gooseberries, currants, cranberries, whortleberries, cherries, unripe mulberries, &c.

Other acids are also found in these fruits, viz. malic, aconitic, and small quantities of acetic and formic.

Prep. The manufacture of citric acid is carried on chiefly in England. Three species of the *Citrus* are used; they are imported from Sicily, Spain, Italy, the West Indies, and the Sandwich Isles. According to R. Warington, in 1875, about 8640 hectolitres (190,000 galls.) of citron and lemon juice, and 480 hectolitres (10,500 galls.) of lime juice were imported and converted into citric acid. The process consists in pressing out the juice from the lemons; separating it from the mucilage, sugar, and other foreign matter with which it is combined; concentrating the juice; and finally preparing the citric acid.

The lemons are peeled (the peel being used to make 'essence of lemon') and placed in pliable baskets, one above the other; the whole is then subjected to pressure. To furnish a pipe (480 litres) of juice, 13,000 lemons are necessary. ('Chémie Industrielle,' Wagner and Gautier.) The juice is then concentrated by boiling it down till the specific gravity becomes 1·239 (after cooling); this is the case when the instrument used, called a *citrometer*, indicates 60°. The liquid is filtered, and run into casks, ready for exportation. On keeping, the concentrated juice often deposits a large quantity of calcium citrate; according to Warington, it is considered to be of normal quality when it contains 415 to 416 grms. of real citric acid to the litre. The concentrated juice from Montserrat is very different from that obtained from citrons and lemons; it is very thick and viscous. The fresh juice is often converted into calcium citrate by the addition of lime or chalk, and exported in this form; that prepared in Spain and Sicily usually contains 80% to 90% of pure calcium citrate. The next step is the decomposition of the citrate by sulphuric acid. The ordinary manufacturing process is as follows:

The concentrated juice is neutralised by the addition of lime, at the same time being gently heated. The calcium citrate is then filtered off, and washed; it is then mixed with water, and decomposed by the addition of sulphuric acid, calcium sulphate and free citric acid being formed. The calcium sulphate is filtered off and washed by means of a filter-pump, and the filtrate containing the citric acid is evaporated down in leaden pans about 40 cm. ($15\frac{1}{2}$ in.) deep, heated by steam. The concentrated boiling liquid is poured into a vat provided with a stirrer, which is kept in motion for 24 hours; the acid is deposited in the granulated state. The mother-liquor is again concentrated, and a second crop of crystals obtained. When no more crystals can be obtained from the mother-liquor, it is diluted, and lime is added just as in the first case.

To obtain colourless crystals of citric acid, the granulated acid is redissolved, and the solution heated with animal charcoal; it is then filtered, concentrated, and allowed to crystallise in lead pans about 7 cm. ($2\frac{3}{4}$ in.) deep. Citric acid is so much more soluble in hot water than in cold, that a hot saturated solution nearly solidifies on cooling.

On the small scale, citric acid may be manufactured as follows:

1. (Ph. L. 1836, *Scheele's* process.) Take of lemon juice, 4 pints; prepared chalk, $4\frac{1}{2}$ oz.; diluted sulphuric acid, $27\frac{1}{2}$ fl. oz.; distilled water, 2 pints. Add the chalk by degrees to the lemon juice, made hot, and mix well; set by, that the powder may subside, and afterwards pour off the supernatant liquor. Wash the precipitated citrate of lime frequently with warm water; then pour upon it the diluted sulphuric acid mixed with the distilled water, and boil the whole for 15 minutes in glass, stoneware, or lead; press the mixture strongly through a linen cloth, and filter it. Evaporate the filtered liquor with a gentle heat, and set it aside, that crystals may form. To obtain the crystals pure, dissolve them in water a second time and a third time; filter each solution, evaporate, and set it apart to crystallise.

2. (*Kuhlman.*) This chemist proposes saturating the hot lemon juice as far as possible with very finely divided barium carbonate, and afterwards completing the neutralisation with barium hydrate or sulphide. The precipitated barium citrate is then to be washed and decomposed with the requisite quantity of sulphuric acid. The advantage of barium over lime as a precipitant is the more ready crystallisability of the citric acid from the solution thus obtained. Sulphate of baryta is absolutely insoluble in solution of citric acid, whilst sulphate of lime is not; and the presence of the latter impedes the crystallisation of the acid.

Obs. If the lemon or lime juice be allowed to ferment a short time, the mucilage and other impurities will, to a certain extent, separate and subside. See *Concluding Remarks.*

Prop., Uses, &c. Citric acid forms rhom-

boidal prisms, which are clear, colourless, odourless, sour, and deliquescent in a moist atmosphere. It is soluble in water, alcohol, and ether. On heating it gives itaconic acid, and, at a higher temperature, itaconic and citraconic acids. It is an agreeable acid, at once cooling and antiseptic. It is much used in medicine as a substitute for lemon juice and to form effervescing draughts, citrates, &c.

17 gr. citric acid, in crystals, or $\frac{1}{2}$ fl. oz. of lemon juice,

are equivalent to

25 gr. bicarbonate of potash;
20 „ carbonate of potash;
15 „ carbonate of ammonia;
20 „ bicarbonate of soda;
35 „ carbonate of soda.

The bicarbonate of potassa is that generally preferred for making saline draughts with citric acid; and when flavoured with a little tincture of orange peel and simple syrup, or syrup of orange peel alone, it forms a most delicious effervescing beverage. Citric acid in pure crystals or in lime juice is much used by the calico-printer, being the best known 'resistant' for iron and alumina mordants. Citrate of tin is used in dyeing with cochineal, with which it gives magnificent scarlet shades.

Impurities. Citric acid is frequently met with adulterated with tartaric acid; the fraud is easily detected by dissolving the acid in a little cold water, and adding to the solution a small quantity of acetate of potash. If tartaric acid be present, a white, crystalline precipitate of cream of tartar will be produced on agitation.

When the crystals of citric acid are very deliquescent, the presence of free sulphuric acid may be suspected. This latter may be detected with facility by dissolving the citric acid in a little water, strongly acidifying the solution with hydrochloric acid and adding chloride of barium, when, if sulphuric acid be present, an insoluble precipitate of sulphate of barium will fall down after a short time. Oxalic acid is sometimes present in citric acid, the cause of its presence being explained further on. To test for it proceed as follows:

Dissolve a small quantity of the citric acid in water, and add to the solution an excess of ammonia; acidify with acetic acid, filter, and test the filtrate with calcium sulphate.

Estim. See ACIDIMETRY and LIME JUICE.

Tests. 1. Citric acid or a citrate chars on heating, and emits a peculiar smell.

2. Sulphuric acid chars it on heating, with evolution of carbonic acid gas, and other products.

3. Calcium chloride gives a white precipitate of calcium citrate with boiling solutions, but not in the cold.

Concluding Remarks. The preparation of citric acid has now become an important branch of chemical manufacture, from the large consumption of this article in various operations in the arts. In conducting the different steps of the process some little expertness and care are, however, necessary to ensure success. The chalk employed, which should be dry and in fine powder, is added to the juice from a weighed sample until the latter is perfectly neutralised, and the quantity consumed is exactly noted. The precipitated citrate of lime is next thoroughly washed with water, and the sulphuric acid, diluted with 6 or 8 times its weight of water, whilst still warm, is poured upon it, and thoroughly mixed with it. The agitation is occasionally renewed for 8 or 10 hours or longer, when the solution of citric acid is poured off, and the residuum of sulphate of lime thoroughly washed with warm water, the washings being added to the liquid acid. This last is then poured off from the impurities that may have been deposited, and evaporated in a leaden boiler over the naked fire, or by high-pressure steam until it acquires the sp. gr. of 1·13, when the process is continued, at a lower temperature, until the liquor becomes syrupy, and a pellicle appears on the surface. Without great care at this part of the process the whole batch may be carbonised and spoiled. At this point the concentrated solution is emptied into warm and clean crystallising vessels, set in a dry compartment, where the thermometer does not fall below temperate. At the end of 4 days the crystals are found ready for removal from the pans. They are thoroughly drained, redissolved in as little water as possible, and after being allowed to stand for a few hours to deposit impurities, again evaporated and crystallised.

The acid of the second crystallisation is usually sufficiently pure for the market; when this is not the case a third, or even a fourth, crystallisation must be had recourse to. The mother-liquors from the several pans are now collected together, and a second or third crop of crystals obtained from them by evaporation as before.

A frequent cause of difficulty in obtaining crystals from the solutions is the employment of too little sulphuric acid to decompose the whole of the citrate of lime; the consequence of which is that a little of that salt is taken up by the free citric acid, and materially obstructs the crystallisation. Forty parts of dry sulphuric acid are required to decompose 50 parts of chalk. Commercial sulphuric acid (oil of vitriol) is usually of the sp. gr. of 1·845, and it therefore requires 49 lbs. of this acid for every 50 lbs. of chalk employed in the process. In practice it is found that a very slight excess of sulphuric acid is preferable to a preponderance of undecomposed citrate of lime.

The first crop of crystals is called 'brown citric acid,' and is chiefly sold to the calico-printers. Sometimes a little nitric acid is added to the solution of the coloured crystals for the purpose of bleaching them, but in this way a minute quantity of oxalic acid is formed. A more general plan is to bleach the citrate of lime by covering it with a weak solution of chloride of lime, exposing it in shallow vessels to the sun's rays, and rewashing it before decomposing it with sulphuric acid. A safer plan is to dissolve the crude citric acid, digest with animal charcoal, and again concentrate the solution to the crystallising point.

When the aqueous solution of citric acid obtained, as already described, is concentrated by boiling in an open evaporating pan, the acid is not only liable to suffer partial decomposition by

its long exposure to the air, but it not unfrequently acquires a brown colour from the carbonisation undergone by those portions of the liquid which are in contact with the bottom of the pan, which being heated by high-pressure steam frequently reaches a temperature exceeding 200° F. This latter result is brought about in consequence of the slight movement in the dense acid liquor in the pan. To remedy the loss and inconvenience arising from the employment of the open evaporating pan, some years back Mr Pontifex devised an apparatus which effects the evaporation of acid liquor *in vacuo* (and therefore out of contact with air), and at a temperature never exceeding 130° F. Moreover, in Mr Pontifex's boiler the time necessary for the concentration of the citric-acid liquor is diminished to about an eighth, and as the strong ebullition keeps the liquid in constant motion its charring is entirely prevented.

Lemon juice may be purified to a great extent by diluting it with water until it contains about 12 oz. of acid to the gallon, and then filtering from the flocculent precipitate of mucilage thus thrown down. The citrate of lime obtained from juice so treated is comparatively pure.

Good lemon juice yields about $6\frac{1}{2}\%$ of crystallised lemon acid; 2 galls. yield fully 1 lb. of crystals. See Lemon Juice, Lime Juice, &c.

CIT'RON. The fruit of the citron tree (*Citrus medica*) is acidulous, antiseptic, and antiscorbutic; it excites the appetite, and stops vomiting; and, like lemon-juice, has been greatly extolled in chronic rheumatism, gout, and scurvy. Mixed with cordials, it is used as an antidote to the manchineel poison. See Manchineel.

Citron, Oil of. See Oil.

Citron Peel. This is prepared in the same way as candied orange and lemon peel, which it for the most part resembles.

Citron. *Syn.* Lem'on colour. The term applied to a pale and delicate shade of yellow. See Yellow Dyes, &c.

CIT'RONELLE. See Liqueurs and Oils (Lemon-grass).

CIT'RUS. A genus of plants belonging to the Nat. Ord. Aurantiaceæ, the species of which yields useful fruits. From *Citrus aurantium* and, its varieties, all the various descriptions of sweet oranges are obtained. The species *C. bigaradia* or *vulgaris* yields the bitter or Seville orange; *C. limonum* and its varieties yield the lemons; *C. limetta* is the source of the lime; *C. medica* of the citron; *C. decumana* of the shaddock; *C. paradisi* of the forbidden fruit; *C. pampelmos* of the Pampelmoose; and *C. japonica* of the kumquat.

Citrus Bergamia. (Ind. Ph.) *Syn.* The Lime tree. *Habitat.* Commonly cultivated in India and other tropical countries.—*Officinal part.* The fruit (lime) closely resembles the lemon, but is smaller, with a smoother, thinner rind, and of somewhat less fragrant odour. Its juice (lime juice) has the same pungent acid taste, and contains the same ingredients as lemon juice, though in somewhat different proportions, that of the citric acid being larger and that of the mucilage less in quantity. Much of the article imported into England under the name of lemon juice is obtained from the lime.—*Prop. and Uses.* Very similar to those of the lemon, the juice being equally refrigerant and antiscorbutic; indeed, it is preferred by many tropical practitioners.

The fresh juice of the lime is procurable in almost every portion of the tropics, and is considered more effectual than preserved lemon juice.

Lime juice may be advantageously employed in the manufacture of citric acid, the proportion of this acid being larger than in lemon juice.

CIV'ET. *Syn.* Civet'ta, Zybeth'um, L. The *Viverra civetta*, or true civet, remarks Mr W. P. Ungerer in 'Science News,' is peculiar to Abyssinia and the southern division of Africa, where it is known by the name of musk-cat. It is distinguished by its projecting teeth, small and piercing eyes, and short, rounded ears. The hair is long and thin, the colour varying from a greyish-black to light grey, darker on the back, where it forms an erectile mane. Its flattened sides are brindled with black, irregular stripes. It is a bloodthirsty animal, of nocturnal habits. The *Viverra zibetha* of India and the Philippine Islands differs in no essential particular save its short and thick hair and a much longer neck.

Nature has furnished the civet with a powerful, odoriferous fluid, secreted in a cavity or pocket divided into two parts, more or less profound, which open near the anus of the animal. This substance is known as civet, or *civette;* it is extracted from him once a week, while he is firmly attached to his cage by means of strong chains and ropes. A small spoon is introduced into the pocket while he is thus helpless and harmless, and the precious perfume is withdrawn with care; he is fed with raw meat, eggs, birds, and small animals.

As a perfume civet is one of the greatest favourites of the Abyssinian and Oriental women; they apply it to their clothes and their hair. About 700 lbs. of civet are used yearly in the United States in the manufacturing of perfumes, not so much for the sweetness of its odour as much as its peculiar and lasting properties; it possesses, like musk, the property, when added in a minute quantity, to augment the odour of other perfumes, without imparting that of its own, thus rendering it a most valuable ingredient in the art of perfumery. Civet is a concrete mass, semifluid, with the consistency of thick honey, and has the peculiarity of keeping in any climate without hardening or putrefying. When taken from the animal it is of a yellow-brown colour, but by exposure the surface turns to a dark brown. We usually receive it in this country in ox and goat horns. It is rarely pure, being adulterated by the natives either with honey or excrements of other animals.

The quantity and quality of civet obtained from this animal depend upon the food upon which he is fed and the way he is kept, the quantity doubling when he is well taken care of. Hundreds of these animals are kept in a state of captivity on the outskirts of Abyssinia, and supply the world with civet.

CLAIRET. See Liqueur.

CLAR'ET RAGS. *Syn.* Tournesol en drapeau, Fr.; Bezet'ta cœru'lea, L. 1. Pieces of clean linen coloured with Auvergne—or ground archil.

2. Pieces of linen dipped into the juice of mulberries, blood-red grapes, lees of red wine, &c.

Used to colour jellies, confectionery, the rind of cheeses, &c.

CLARIFICA'TION. The act of clearing or making bright; commonly applied to the process of 'clearing' or 'fining' the liquids by chemical means instead of by filtration. The substances used for this purpose are popularly known as 'clarifiers' or 'finings.'

The substances employed in the clarification of liquids operate by either mechanically embracing the feculous matter, and subsiding with it to the bottom of the vessel, or by inducing such a change in its nature or bulk that it subsides by its own density, in each case leaving the liquor transparent. Albumen, gelatin, the acids, certain salts, blood, lime, plaster of Paris, alum, heat, alcohol, &c., serve in many cases for this purpose. The first is used, under the form of white of egg for the clarification of syrups, as it combines with the liquid when cold, but on the application of heat rapidly coagulates and rises to the surface, carrying the impurities with it, forming a scum which is easily removed with a 'skimmer. It is also much used for fining wines and liqueurs, particularly the red wines and more limpid cordials. Gelatin, under the form of isinglass, dissolved in water or weak vinegar is used to fine white wines, beer, cider, and similar liquors that contain a sufficient quantity of either spirit or astringency (tannin), to induce its precipitation. Sulphuric acid is frequently added to weak liquors for a similar purpose, either alone or after the addition of white of egg or gelatin, both of which it rapidly throws down in an insoluble form. A pernicious practice exists amongst unprincipled manufacturers of using certain salts of lead and potash to clear their liquors; especially those that are expected to sparkle in the glass, as 'cordial gin,' &c. For this purpose a little sugar of lead, dissolved in water, is first mixed up with the fluid, and afterwards a little more than half its weight of sulphate of potassa, also dissolved in water, is added, and the liquor is again 'roused' up. By standing, the sulphate of lead, formed by this mixture, subsides, and leaves the liquor clear. Bullocks' blood is used in the same way as isinglass or white of eggs, for fining red wines, beer, and porter. Lime, alum, alcohol, acids, and heat, act by curdling or coagulating the suspended matters, and thus, by increasing their density, induce their subsidence. Plaster of Paris acts, partly like the above, and partly like albumen, or gelatin, by enveloping and forcing down the suspended matter. Sand is often sifted over liquors (especially cordials and syrups), for the simple purpose of acting by its gravity, but appears to be quite useless, as it sinks too rapidly. The juices of plants are clarified by heat, which coagulates the albumen they contain. Marl or clay is frequently used to clear cider and perry. A strip of isinglass is generally employed to clarify coffee. See BREWING, COFFEE, CORDIALS, FININGS, INFUSION, WINE, &c.

CLAY. Clay is formed from the disintegration of felspathic rocks, by the combined action of air and water. Its plasticity, when moist, and its capability of being made hard by heat, are properties which render it available for many useful purposes. The purest kind of clay is kaolin, or China clay, which consists almost entirely of silicate of aluminium. It is found in China; but a precisely similar substance is obtained from deposits in Cornwall and some parts of France. Pipe-clay, a white clay nearly free from iron, is found in large quantities in the island of Purbeck. Potters' clay is found in many parts of Britain; that of Devonshire and Dorsetshire is much valued. Brick-clay contains varying proportions of iron; hence the different colours of the bricks used in different countries. See ALUMINUM, FULLER'S EARTH, OCHRE, &c.

CLEAN'ING. In domestic economy the best way to clean a house is to keep it clean by a daily attention to small things, and not allow it to get into such a state of dirtiness and disorder as to require great and periodical cleanings. Some mistresses and also some servants, seem to have an idea that a house should undergo regular cleanings, or great washing and scrubbing matches, once every 3 or 6 months, on which occasions the house is turned almost inside out, and made most uncomfortable. All this is bad economy, and indicates general slovenliness of habits (*Chambers*). For hints upon cleaning, see CARPETS, CLOTHES, &c.

CLEAN'LINESS. See ABLUTION, BATHING, and SICKNESS.

CLIPPING (Horses). Some horses should be worked in autumn in cloths, or with their coats on, as, on account of the extra sweating thus caused, they will be in better condition for the hunting season. Such horses should be clipped or shaved. The horse's coat should be fully set before it is clipped. Those horses which sweat much in autumn should be singed, Singeing cannot be begun too early. The fresh growth must be removed every week. Singeing may be best accomplished by means of gas.

CLISIOCAMPA NEUSTRIA, Linn. The Lackey Moth. The large larvæ or caterpillars of this moth, which is known as the 'lackey' moth in England, and is termed livrée in France because of its peculiar markings like a footman's livery, are destructive to the foliage of several kinds of trees and especially to the leaves and blossoms of apple trees in some seasons. They do not cause so much injury as the larvæ of the *Hyponomeuta padella*, though the time and method of their attack are somewhat similar. In certain districts they have not infrequently stripped apple trees of their leaves and blossoms, but not so commonly or so extensively as the *Hyponomeutæ*.

This moth is called *Clisiocampa* because its larvæ congregate under webs, or tents; and the affix *neustria* is given to it as this was the name of the western part of France in the eighth century, in the days of Charlemagne ('The Great Historical Dictionary,' by Jer. Collier, A.M., 1688). It would appear from this that the insect has been known in the apple orchards of Normandy and Brittany for a very long period. At this time it causes great losses in the western part of France, where apple trees are cultivated mainly for cider, as well as in the central departments. It is far more injurious in France than in this country, so much so that from time to time decrees and regulations are promulgated as to measures and precautions to be taken

against it. A moth of similar species named *Clisiocampa americana*, by Harris, is well known in America and Canada as injurious to apple trees in a manner identical with that of its European congener. Köllar and Kaltenberg both write of the *Clisiocampa neustria* as doing much harm to the apple-crop in Germany, and a German fruit-grower writes from Würtemberg that it was very troublesome there 3 or 4 years ago; and Guérin Méneville says it is one of the most injurious species to fruit and forest trees in France ('Essai sur les Lepidoptères du genre Bombyx,' par F. E. Guérin Méneville). In England it does not often clear off the leaves and blossoms from the apple trees of whole parishes and districts, but fixes upon certain trees here and there for the most part; though in parts of Kent and Gloucester 4 and 5 years ago, and before, in 1865, its attack was of a more general character.

Pear trees are occasionally beset by the caterpillars of this moth in a similar manner to apple trees.

Life History. This insect belongs to the Nat. Ord. LEPIDOPTERÆ and to its family *Bombycidæ*, to which also the silkworm, *Bombyx mori*, belongs.

It measures, in its moth state, about 18 lines, or 1½ inches across its expanded wings, while its body is close upon 8 lines in length. The head is so small as to be hardly seen unless the moth is turned on its back. Its normal colour, or rather that of the female, is a dull red, described by Stephens and Westwood as a rusty fox colour. That of the male is somewhat lighter, with tinges of yellow. Upon the anterior or fore-wings there are two transverse bars of a pale colour traversing them obliquely. According to Curtis, Stephens, and Westwood, the colour and markings vary considerably, and it is said that no less than four variations of these have been noticed in individual moths of this species.

Towards the end of July or the beginning of August the female moth lays her eggs in a peculiar fashion, placing them in rows round the spurs or twigs of the fruit trees, and fastening them firmly to these with a viscous material, which does not cover them, but merely keeps them in place. They are able to withstand the hardest frost and all influences of weather. Mr Whitehead has known them remain quite unaffected after 14° of frost.

From 100 to 250 eggs are laid by each moth, and are hatched out as soon as the leaves are formed. Unlike the caterpillars of *Hyponomeuta padella*, these caterpillars do not ensconce themselves singly and snugly in the whorls of the leaves, but congregate together under a tent of webs which they jointly spin, and live altogether, feeding the leaves and blossoms around them. On warm days they may be seen basking in the sun on the confines of their tents. They are hairy, of a dark grey colour, with three bright red stripes on each side of the body, and a white stripe down the back. When fully grown they are nearly 1½ inches long. From their size and voracious appetites they are most dangerous enemies to fruit trees. According as the foliage is devoured within their range, or within the area of the web, this is enlarged and extended. After a time, when the food fails, or when the food becomes less succulent in the heat of midsummer, the caterpillars withdraw from society, and, leaving their tents, crawl to some safe retreat, either in the ground among leaves and rubbish, or in the chinks of fences or posts close to the fruit trees, or the bark of trees. In this retirement they spin yellow cocoons, from which the moths appear in about 10 days.

Prevention. Being somewhat heavy on the wing the moths do not take long flights, and they fly in the twilight and during the night, and may be seen in the evenings hovering over grassy tufts and weeds and flowers, by the sides of woods and hedgerows on the outsides of fields and orchards. Here they find shelter and refuge during the day, therefore it is most important to keep the outsides of orchards and fruit plantations well brushed and free from weeds and grasses, and not to allow long grass to remain in orchards under the fruit trees.

It may be said here that for the prevention of the attacks of insects, and for the general benefit of grass orchards, these should be eaten close down by sheep, corn or cake-fed, and kept close down throughout the year. Hiding places of insects are greatly diminished if this is adopted, and the feet of the sheep destroy or disturb insects in various stages of their existence. In large orchards the caterpillars of the lackey moth crawl down the stems of trees, and let themselves down to the ground by means of silken lines, in order to go through the chrysalis stage in safety there. Some probably get into the fissures in the bark of the trees. It is obvious that they cannot get far from the trees on which they have lived; therefore they will either be in the grass and rubbish on the ground or in the bark. After an attack in this case the grass should be fed down as closely as possible, or, if sheep are not procurable, mown short, and the ground well trampled round about the trees. The bodies of the trees, which in well regulated orchards have been denuded of the useless and rough outside layers of bark, should be treated with hot lime wash, or smeared over with a thick composition of soft soap in which there is a considerable quantity of paraffin oil, or with the mixture of petroleum and soft soap.

In cultivated ground planted with apple trees quicklime or lime ashes should be hoed in with those excellent tools known in Kent as 'prong' hoes (these are hoes with three flattened prongs, having handles like ordinary 'plate' hoes, and very stout heads or 'eyes' to beat down hard clods.—C. W.), and much used in fruit plantations and hop grounds. A thorough hoeing with these and the complete pulverisation of the ground around the trees might suffice to destroy the caterpillars or the chrysalids without lime.

Some writers recommend that the apple trees should be closely examined during the winter to discover the eggs upon the spurs and twigs. It is hardly practicable that this can be done upon a large scale in orchards, thought it might be done in gardens.

Remedies. The groups of caterpillars in their tents may be dislodged and destroyed. In France and Germany they dislodge or cut

off these groups, *bouquets de chenilles*, as they term them, with long poles with hooks at the end, and destroy them. This could hardly be adopted in a serious attack in large orchards or plantations.

If the attack were slight and confined to trees here and there it would probably pay well to carry out this operation. Ladders would of course be required to enable the men to reach the topmost branches with the hooks. In gardens it should certainly be adopted.

Syringing the branches with soft soap and water, with a strong infusion of quassia, or with water and paraffin in the proportion of a wineglass of oil to a gallon of water, would be of service if thoroughly well performed, though the webbed tents of the enemy would serve to protect them against ordinary syringing, or squirting, as it is termed in hop districts ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

CLOTHES. Economy and cleanliness require due attention to be paid to every article of clothing, but more especially to those which are the most exposed to dirt and the weather. The following remarks, having reference chiefly to woollen articles, may prove useful to the reader:—If very dusty, hang them on a horse or line, and gently beat them with a cane; then lay them on a clean board or table and well brush them, first with a stiff brush, to remove the spots of mud and the coarsest of the dirt, and next with a softer one, to remove the dust and to lay the nap properly. If clothes are wet and spotted with dirt, dry them before brushing them, and then rub out spots with the hands. The hard brush should be used as little as possible, and then with a light hand, as it will, if roughly and constantly employed, soon render the cloth threadbare. Spots of tallow-grease on the clothes may be taken off with the nail, or, if that cannot be done, have a hot iron with some blotting-paper, lay the paper on the part where the grease is, then put the iron upon the spot; if the grease comes through the paper put on another piece, till it ceases to soil it. A small clean sponge wetted with benzine will often take out grease which does not yield to the hot iron; a piece of blotting-paper should be placed on the under side, to absorb any benzine which may run through. Pipe-clay well rubbed in and then beaten out with a cane will answer the same purpose with thick woollen materials. Moths may be prevented attacking clothes by putting a few cloves or allspice into the box or closet with them. Moth is best prevented by constantly turning out drawers and wardrobes, exposing the articles to light and air, and shaking them well; camphor sewn in small linen bags should be packed with all woollen clothing; the odour is quickly removed by hanging the articles before the fire for a short time. Russia-leather clippings are said to answer the same purpose. In the tropics the most constant and unremitting attention is required to prevent the attacks of insects, and nothing short of metal-lined boxes with air-tight covers is of much avail. See Balls, Clothes, and Scouring, &c.

CLOTHING. The object of clothing is twofold: to protect our bodies against the weather and against injury by external objects. These two purposes are in many respects separate and distinct from one another, but the clothing usually worn in everyday life is more or less a compromise between the two, and in the same climate the variations from the standard are almost entirely determined by difference of occupation.

The chief object of clothing being protection against the weather and the maintenance of the body at a comfortable temperature, it is obvious that climate will exert a profound influence upon the character of the clothing of the inhabitants of any individual country. The skins and furs of the Esquimaux would be intolerable in England, whilst in the tropics the temperature is such that clothing can hardly be said to be worn by the natives at all.

The dress of all civilised nations consists of two essential parts, underclothing and outer clothing, and it will be well to consider these separately.

Underclothing. This being next the skin should possess two qualities in addition to that of warmth; it should allow free interchange of air between the surface of the skin and the atmosphere, and should not retain moisture to any perceptible extent.

Warmth may be secured at the expense of the other two qualities, and a suit of soft flexible paper would be very efficient in this respect, but the want of ventilation and the retention of the perspiration would render such a garment absolutely intolerable. A new linen shirt with a capacious and well-starched front affords an excellent criterion of the effects of an impervious garment, and the wearing of a close-fitting mackintosh coat for a short time is so unpleasant that it is preferable to take the risk of wetting. The material of underclothing should therefore be as non-conducting as possible, and this non-conducting quality should remain to as great an extent as possible when the material is so woven as to allow of perfect ventilation. Linen is very durable, but as it conducts readily is not a good material to place next the skin. Further, it absorbs moisture readily, and if the wearer perspire much, his underclothing will rapidly become soaked and impervious to air and uncomfortable in the last degree. The same applies, though to a less extent, to cotton; and there is no room for doubt but that fine wool is the best material for the purpose; it is non-absorbent or nearly so; it is a very bad conductor of heat, and it is warm even when so loosely woven as to give a maximum of ventilation to the skin. Many persons object to it on the ground that it is irritating, and there may be some persons whose skins are so delicate that they are not able to tolerate the slight stimulation produced. In all but these rare cases it is purely a question of habit, and it may be stated as a fact that in all climates woollen underclothing is the best and healthiest, due regard being had to the thickness of the material in relation to the temperature. In recent years the use of undyed wool has greatly increased, and the introduction of the so-called 'Jaeger system' of wearing only clothing made from the 'natural wool,' though many virtues

have been attributed to the material by its inventors which it certainly does not exclusively possess, has done much to extend the use of woollen underclothing. The Jaeger material is simply pure wool, so woven as to be as porous as possible consistent with the retention of the warmth-giving property, and as such it answers its purpose admirably; how far it is necessary to carry out the principle in every article of clothing, even to boots, is perhaps somewhat doubtful.

An individual clothed from head to foot in a fine woollen material is protected against changes of temperature in a manner which is hardly credible to those who have not tried the experiment. The popular notion that such clothing will be intolerable in hot weather is entirely erroneous; and it is possible, in England at all events, so to adjust the thickness of the material that the same kind of clothing, both under and outer, may be worn all the year round without discomfort. The wearer will, however, if he be ordinarily active and his employment does not necessitate exposure to cold under such conditions that he cannot keep warm by exercise, rarely find it necessary to wear an overcoat or other extra wraps, and he will be more or less insensible to changes of temperature which would be acutely felt by persons whose underclothing is of cotton or linen. Children should be accustomed to woollen underclothing from their earliest years, and much anxiety will be saved to those who have the care of them in a greatly diminished liability to take cold or suffer from the effects of chill or wetting. All underclothing should fit the body comfortably; the collars of shirts *can* be cut so as to be loose and still keep their place, and the space between the neck and the shirt-collar is, as it were, the chimney of the clothing, from which a large amount of the heated air from the surface of the body makes its escape; the waistbands of drawers should be broad, and the practice of attaching loops through which the braces are passed is greatly to be commended, as the waist is thereby relieved from pressure, and ventilation is secured.

Woollen socks or stockings should always be used, and the thickness regulated by the boots to be worn and the work to be done. A heavy boot necessitates a thick sock; cotton is harsh and chafes the feet, while silk is hardly elastic enough, and is, moreover, very costly. The weight of boot and thickness of sock worn by most persons is very largely a matter of habit. Those who have been brought up from childhood to wear light boots and thin merino socks will often march better and with less damage to the feet than many who find a heavy boot and thick sock necessary to protect them.

Outer-clothing. Of this little need be said except that it should be suited to the occupation of the wearer, and there is no doubt but that wool is the best material. The dress of women is to a very large extent responsible for their more or less sedentary habits; it is but too often made of materials which are destroyed by rain and mud, and healthy exercise is sacrificed in consequence.

Clothing of Children. The long clothes of infants are very objectionable; they interfere with freedom of movement, and answer no useful purpose whatever. An infant's garments should be loose and warm, and the underclothing should be of wool, light and fine, and carefully washed, so as to remain soft and pliable. The same may be said of the clothing of older children. The fewer the garments the better, and the amount of clothing should be so regulated that they shall not be greatly affected either by heat or cold. It is essential to the comfort of children that their clothes should be such as not to interfere with their absolute freedom of movement. Nor should it ever be necessary to restrain their enjoyment of any games or exercise from fear of spoiling their clothes; the conversion of young children into fashionably-dressed adults is a custom which cannot be too strongly deprecated.

CLOVE. *Syn.* CARYOPH'YLLUM (B. P.), L. The flower-buds of the *Eugenia caryophyllata*, or clove tree. Originally brought from the Moluccas; now cultivated for this valuable spice in Zanzibar, West Indies, Guiana, Brazil, and most tropical countries. Cloves are collected for market in the Moluccas either by gathering them by hand, or by beating the branches with long bamboos, cloths being placed beneath the trees to receive them. Many varieties are known in commerce, those from Penang being considered the best.

The flower-buds of the clove tree when young are nearly white, but afterwards become green, and lastly bright red, when they are at once gathered. The buds are dried in the sun, and thus acquire their dark-brown tint. Cloves are aromatic, stimulant, carminative, and stomachic; and, according to some, possess febrifuge properties. They are chiefly used as an adjuvant in compound medicines. A few cloves kept in a closet or box prevent moths or mould attacking furs, woollens, &c.

It is a common practice to adulterate this spice in the same manner as cinchona bark. Cloves from which the oil has been distilled are dried and rubbed between the hands, previously moistened with a little sweet oil, to brighten their colour, after which they are mixed up with fresh spice for sale.

Cloves, Mother of. The unripe fruit of the clove tree; they are frequently imported preserved (preserved mother of cloves), and are reputed stomachic and antispasmodic.

Cloves, Oil of. *Syn.* O'LEUM CARYOPH'YLLI (B. P.), L. This possesses similar virtues to the unexpanded flower-buds, and is esteemed as a remedy for the toothache. Used to flavour liqueurs and confectionery. Sp. gr. 1046—1058.

M. Jacquemin recommends the following as a very delicate test for the presence of carbolic acid when used as an adulterant for oil of cloves. One drop of the suspected oil is mixed with a small trace of solution of aniline by means of a glass rod, and then shaken with 5 or 6 c.c. of distilled water. By the addition of a few drops of sodium hypochlorite to the mixture the characteristic blue coloration due to carbolic acid will be developed in a few minutes, whereas with the pure oil nothing but the purplish-violet colour of aniline will be perceived. Stirring or shaking must be avoided after the addition of the hypochlorite.

CLYSTERS. See ENEMA.

COAL. The varieties of this valuable substance

may be conveniently described under the three heads ANTHRACITE, LIGNITE, and PIT-COAL (which *see*). See also FUEL.

COAL-TAR. Coal-tar, one of the products of the destructive distillation of the coal employed in the manufacture of gas is a very complex substance, consisting of various hydrocarbons, acids, and bases, together with certain resinoid and empyreumatic substances. The quantity as well as the quality of the tar obtained from the distillation of coals varies considerably with the kind of coal used, as well as with the temperature at which the distillation is carried on, the yield of tar being smaller at very high temperatures than when lower ones are employed. Coal-tar, from its antiseptic properties (due chiefly to the carbolic acid it contains), is painted on wood to preserve the latter from decay when exposed to the wind and weather. Mixed with coal-dust, sawdust, and peat-dust, it forms a useful artificial fuel, and when incorporated with pebbles makes an excellent artificial asphalt for pavements. The chief value of coal-tar, however, consists in its being the source of those brilliant dye-stuffs, the coal-tar colours. These, together with the naphtha obtained from its distillation, have converted coal-tar from a worthless and unwelcome waste product of gas manufacture—for the removal of which from their premises the gas makers were formerly only too glad to pay—into a very considerable and important branch of profit and revenue.

The coal-tar is distilled in iron retorts; it contains three sets of products: (*a*) *those volatile at a low temperature;* (*b*) *those volatile at a high temperature;* (*c*) *those not volatile at the temperature of the still.*

(*a*) *Those Volatile at a Low Temperature.* The distillate, which in the first instance comes over with the steam, is called *light oil,* owing to the fact that it is lighter than, and consequently floats on the surface of, the condensed water. Every 100 parts of tar yield about 10 of light oil.

The light oil contains benzene, toluene, xylene, cymene, &c., contaminated with more or less 'dead oil.' The light oil is again distilled, the distillate forming what is called *coal-naphtha;* a quantity of 'heavy oil' remains in the retort. The coal-naphtha is purified by shaking it up; first with sulphuric acid, whereby basic substances are removed; then with a dilute solution of potash, to separate carbolic acid, &c.; and finally with water. When decanted from the water, it forms 'rectified coal-naphtha.' This composite liquid may be separated into its various constituents by fractional distillation:

From—

175° to 180° F.	(79·4° to 82·2° C.)	it yields	benzene
180° „ 235° F.	(82·2° „ 113° C.)	„	toluene.
284° „ 293° F.	(140° „ 145° C.)	„	xylene.
336° „ 342° F.	(169° „ 172° C.)	„	cymene.

Commercially, that portion which distils over between 175° and 250° F (79·5° and 121·1° C.), is designated, and sold as benzol or benzene.

(*b*) *Those Volatile at a High Temperature.* These constitute the liquid called 'dead oil,' or 'yellow oil,' from its peculiar colour, or 'heavy oil,' from its being heavier than, and therefore sinking in, water. The last portions that distil over become nearly solid on cooling. Every 100 parts of tar yield about 25 of dead oil. Dead oil contains carbolic acid, naphthalene, anthracene, aniline, guinoline, &c.

Among the *first* products of the distillation of dead oil is *carbolic acid,* $C_6H_5.OH$. It comes over chiefly between 300° and 400° F. (149° and 250° C.), and is largely used for creosoting timber.

Among the last products of the distillation is *anthracene,* $C_{14}H_{10}$, a substance of great commercial value in the manufacture of artificial alizarin. The first portion of the anthracene that distils over is mixed with naphthalene, $C_{10}H_8$, and the last with chrysene, $C_{18}H_{12}$. Anthracene is purified in the first instance by re-distillation, the first and last portions being rejected. The intermediate portion is purified by crystallising either from its solution in alcohol, or in coal oils boiling between 212° and 248° F. (100° and and 120° C.).

(*c*) *Those not Volatile.* These constitute the black residue in the retort, called *pitch.* It is used in the preparation of Brunswick black, asphalt, &c. ('Handbook of Modern Chemistry,' Dr Meymott Tidy).

COBALT. Co. *Syn.* COBALTUM, L. Atomic weight, 58·8. A metal discovered by Brandt in 1733. It generally occurs in the same ores as nickel, and the separation of the two metals is a task of considerable difficulty. Its chief ores are smaltine, $CoAs_2$, and cobalt glance, CoAsS, with cobalt partially replaced by iron and nickel. For the manufacture of the cobalt colouring-substances, the ore is roasted in a blast furnace to oxidise the cobalt, and volatilise the sulphur and arsenic; the product is known as 'zaffre,' and is used in preparation of smalt, cobalt-blue, Rinmann's green, &c.

Prep. The metal in the pure state may be prepared in the following manner: The roasted ore is dissolved in hydrochloric acid, and treated with slaked lime to remove the iron; then with sulphuretted hydrogen, to remove the copper and bismuth; and then with calcium hypochlorite, which precipitates the cobalt as hydroxide, $Co(OH)_2$. To remove any nickel, the hydroxide is dissolved in nitric acid, the solution is neutralised by caustic potash, acidified with acetic acid, and potassium nitrate is added. The solution is allowed to stand a few days, when all the cobalt will be precipitated as the double nitrate of cobalt and potassium; the precipitate is then filtered off, washed, dried, and ignited, again washed and dried, when pure oxide of cobalt, Co_2O_3, is obtained. To obtain the metal from the oxide, it may be reduced at a red heat by a current of hydrogen, or it may be converted first into the oxalate, which yields the metal on ignition at a white heat in a closed crucible.

Prop., Use, &c. Cobalt is a greyish, brittle metal; unchanged in the air; has a high melting-point; and is feebly magnetic. It dissolves in dilute acids, forming cobaltous salts. It is seldom employed in the metallic state, owing to the great difficulty of reducing its ores, but its oxide (black oxide) is largely employed in the arts. It forms salts with the acids, which are interesting from the remarkable changes of

colour which they exhibit. See INK, SMALTS, ZAFFRE, and *below*.

Char., Tests. Solutions of salts of cobalt may be recognised by the following reactions:—1. Ammonia, in the absence of ammonium salts, gives a blue precipitate, slightly soluble in excess, giving a brownish-red colour. 2. Potash gives a blue precipitate, turning to violet and red when the solution is heated. 3. Carbonate of ammonium and carbonate of sodium give pink precipitates; that from the former is soluble in excess. 4. Cyanide of potassium gives a yellowish-brown precipitate soluble in excess; and the clear solution, after being boiled, is unaffected when mixed with hydrochloric acid. 5. Sulphuretted hydrogen produces no change in acid solutions. 6. Sulphydrate of ammonium gives a black precipitate in neutral solutions. 7. Melted with borax before the blowpipe, it gives a head of a magnificent blue colour, almost verging on black, if much is present. Phosphate of sodium and ammonium give a similar bead, but the colour is less intense.

Cobalt, Ace'tate of. $Co(C_2H_3O_2)_2$. *Prep.* From the carbonate or monoxide and acetic acid. It forms a sympathetic ink which turns blue when heated.

Cobalt, Arseniate of. $Co_32AsO_4,8H_2O$. A hydrated native tricobaltous arseniate of cobalt, known as 'cobalt bloom.'

Cobalt, Car'bonate of. $CoCO_3$. *Prep.* By adding an alkaline carbonate to a solution of a salt of cobalt. A pale peach-coloured powder, soluble in acids. It contains some hydrate.

Cobalt, Chlo''ride of. $CoCl_2$. *Prep.* By dissolving the carbonate or monoxide in hydrochloric acid; on standing, the solution deposits deep rose-red crystals, which contain water. By evaporating the solution by heat, anhydrous blue crystals of the chloride are obtained. Both of them yield a deep rose-red solution with water, which is turned green by a little acid. This solution forms a well-known sympathetic ink, the traces of which become blue when heated. If the solution contains either chloride of iron or chloride of nickel, the traces become green (*Klaproth*). The addition of a little nitrate of copper to the above solution forms a sympathetic ink, which by heat gives a very rich greenish-yellow colour (*Ure*). The addition of a very little common salt makes the traces disappear with greater rapidity, on the withdrawal of the heat. In each case, when the paper is laid aside, moisture is absorbed, and the writing once more disappears. If, however, too high a temperature has been used, the traces become permanent.

Cobalt Monoxide. CoO. A greenish brown powder, slightly hygroscopic; prepared by precipitating a solution of chloride or sulphate of cobalt with sodium carbonate, and washing, drying, and igniting the precipitate in the absence of air; it may be prepared also in the same way from the hydroxide, $Co(OH)_2$, which is obtained by adding potash to a solution of cobalt salt and allowing to stand, in the absence of air. It is remarkable for the magnificent blue colour it imparts to glass, and by this property its presence may be readily detected before the blow-pipe, the substance to be examined being fused with borax on a loop of platinum wire. It is used to make blue colours for painters, stains and glazes for enamellers, glass-melters, potters, &c. In *medicine*, it has occasionally been given as a remedy for rheumatism.

Cobalt, Nitrate of. $Co(NO_3)_2$. *Prep.* As the chloride, substituting nitric for hydrochloric acid; it forms deliquescent crystals.

Cobalt, Oxalate of. CoC_2O_4. *Prep.* Similar to that of the acetate; from oxalic acid and the carbonate or oxide; or by double decomposition.

Cobalt, Oxides of. Of these there are several, but the most important are the monoxide, and the sesquioxide.

Cobalt, Phos'phate of. $Co_3(PO_4)_2$. *Prep.* As the acetate, substituting phosphoric for acetic acid. An insoluble purple powder, which, when heated along with 8 times its weight of gelatinous alumina, produces a blue pigment (COBALT BLUE, COBALT ULTRAMARINE), almost equal in beauty to ultramarine (see *below*).

Cobalt Sesquioxide. Co_2O_3. *Syn.* PEROXIDE OF COBALT. A steel grey, lustrous solid; prepared by heating the nitrate, $Co(NO_3)_2$, so long as red fumes are evolved. Heated in air, it gives the oxide, Co_3O_4. It may be obtained as the hydrate, $Co_2O_3.3H_2O$, by adding bleaching powder to a solution of a cobalt salt.

Cobalt, Sul'phate of. $CoSO_4$. *Prep.* By dissolving the oxide in the acid. It forms reddish crystals, soluble in 24 parts of water.

Cobalto-Ultramarine. A fine blue pigment, prepared by mixing freshly precipitated alumina, 8 parts, with phosphate or arseniate of cobalt, 1 part; drying the mixture, and then slowly heating it to redness. By daylight the colour is pure blue, but by artificial light it is violet. See BLUE PIGMENTS.

COCA. Erythroxylon Coca. This plant is grown largely in Peru and Bolivia. The Bolivian coca is said to be much superior to the Peruvian. The best kind is believed to come from the province of Yungas, and the most inferior description from Peru. The consumption of coca in Peru, Bolivia, and in some of the provinces of the Argentine Confederation is enormous.

The plant was first described so long ago as 1580 by Monardes. Referring to the method of using coca, he says it was made either in the form of balls, of a paste made by chewing the leaves with lime, or chewing the leaves alone. "For the use of these little balls taketh the hunger and thirst from them; and they say that they receuive substance thereby as though they did eate meate." The plant was first figured in this country in 1836, and from about that time, and for many years afterwards, coca leaves were looked upon as the source of a stimulant to the nervous system, employed by the inhabitants of Peru and Bolivia in very much the same manner and for the same purpose as the Chinese use opium, and the East Indians chew betel. The published statements from Monardes onwards respecting coca appear to establish the fact that its use by the Indians of the Andean region enabled them to accomplish such severe labour as no European could perform. Von Tschudi refers to the effect the use of coca had on himself in greatly assisting respiration, and in enabling him to ascend high mountains without

fatigue. According to De Candolle, the original home of the coca plant in South America has not been clearly defined. At the present time it is cultivated to a very large extent in the Andes of the Argentine Republic, of Bolivia, Peru, Ecuador, and the United States of Columbia. It is cultivated also in the mountainous parts of Brazil. The largest plantations are said to be in the province of La Paz, in Bolivia. A good harvest is said to yield 900 *lbs.* of coca leaves per acre, and the total production is said to amount to about 40,000,000 *lbs.*, representing a value of £2,000,000, almost the entire produce being consumed in South America. Several varieties of the plant are known, the result of cultivation, one form of which, it is stated, has been under cultivation at Kew for more than twenty years, and was first raised from seed in 1869. From this plant some hundreds have been raised, which have been distributed to different parts of the world. In many of the British colonies this is the only coca plant under cultivation, and is described as *Erythroxylon coca* var. *novo granatensis.* The leaves are said to be generally smaller than the typical Peruvian leaves, and approach very nearly (although not so coriaceous) to what are known in commerce as Truxillo leaves. Under the head of 'Chemical Notes' some interesting facts are given, the result of analyses made by Mr Alfred G. Howard, which go to prove that leaves grown in Ceylon show exceptional richness in crystallisable cocaine. Of two samples grown at the Botanic Gardens, Peradeniya, the leaves of one dried in the shade yielded ·60% of cocaine, while the same leaves dried in the sun yielded only ·47%. Leaves grown in Ceylon at 1500 feet and 3000 feet respectively show the same results, the difference of elevation apparently producing no effects on the yield in cocaine. The results of the investigation seem to show that the typical plant, or true *Erythroxylon coca,* is the best to cultivate at higher elevations, and if the object is to obtain a large yield of crystallisable cocaine. The variety *novo granatensis* thrives at sea-level in the tropics, and yields nearly, if not quite as high a percentage total cocaine, but a large proportion of it under present chemical methods is uncrystallisable. The latter plant, judging from cultivated specimens in this country, appears to yield a larger crop of leaves than the typical, but fruits somewhat sparingly. Analysis of other species of *Erythroxylon* show that the yield of alkaloids is extremely small, not sufficient to justify their adaptation for commercial purposes.

In small doses it is supposed to act as a stimulant and to aid digestion; in large ones it is said to possess dangerous narcotic properties. The mountaineers in South America state they are enabled to reach high elevations without difficulty of respiration, and to stave off the feeling of hunger by chewing the leaves during their ascents. "Good quality coca should have its leaves unbroken, of a medium size, bright green in colour, of an odour somewhat combining that of hay and chocolate. The taste is bitter, and, when masticated, coca is said to yield easily to the teeth. Infused in hot water, it has a beautiful green colour, which, however, is much darker from inferior leaves. An infinite number of varieties are recognised between the best and the lowest quality, which has a disagreeable smell and a colour resembling roasted coffee. The leaves are also bent and broken, scarcely a whole leaf being found amongst them" ('Pharmaceutical Journal'). Sir R. Christison, writing to the 'British Medical Journal,' April 29th, 1876, states he was hardly sensible of the fatigue of two mountain descents made from Ben Vorlich after chewing coca leaves. That, as a consequence of his doing so, hunger and thirst were suspended for a long time, but that eventually appetite and digestion were unaffected. He made trial during the first descent of 60 gr., and of the second, undertaken 8 days after, of 90 gr. of coca.

The principles met with in the leaves are *cocaine, hygrine, ecgonine.*

The coca-leaf contains from 0·02% to 0·2% of cocaine, according to quality. The mode of extraction has also a marked influence on the yield.

COCAINE. $C_{17}H_{24}NO_4$. Cocaine is the alkaloid of the leaves of *Erythroxylon coca.* It was first isolated in 1855 by Gaedeke, who gave it the name of *Erythroxyline;* but Dr A. Niemann, of Goslar, was the first to thoroughly investigate the leaves in 1860, and gave the alkaloid its present name. In September, 1884, Dr Karl Kohler, of Vienna, brought it prominently into notice by his paper read at the meeting of the Heidelberg Ophthalmological Congress, wherein (illustrated by experiments) its value for the purpose of producing local anæsthesia was demonstrated, particularly in operations upon the eye. Since this the literature upon the subject has grown to very extensive proportions, and new evidence as to the value of cocaine is being continually given, and it may now be said with certainty that it acts not only upon the eye, but on the mucous membrane of the ear, mouth, tongue, pharynx, nose, larynx, trachea, urethra, vagina, and rectum. It is but slowly absorbed by the skin, but quickly absorbed by cut or abraded surfaces and by open wounds.

Cocaine crystallises in the mono-clinic system; it melts at 98° C.; it dissolves in alcohol, still better in ether, and in 704 parts of water. It can also be dissolved in 20 parts of fused vaseline or in castor oil.

Heated with concentrated hydrochloric acid, it splits up into *ecgonine, benzoic acid,* and *methylic alcohol.*

The salts of cocaine met with in trade at the present time are the *hydrochlorate,* the *salicylate,* the *hydrobromate, tartrate,* and *citrate.* The hydrochlorate is the most used. It has the appearance of a white amorphous powder, but is really crystalline; it possesses a peculiar odour, dissolves in 4 parts of water, and is very soluble in alcohol. In 1860 Niemann said that cocaine produced *temporary insensibility* on that portion of the tongue which it touches. This interesting fact lay hidden for 24 years, until Dr Koller thought he would try hydrochlorate of cocaine to induce anæsthesia in laryngoscopic observations; and soon after, in September, 1884, Dr Brettaner, of Trieste, demonstrated its anæsthetic properties in a weak solution (2% to 4%)

applied to the eye in ophthalmic cases. Since then hundreds of observers have experimented with it.

Uses. Local anæsthetic. Applied to the tongue, it destroys the sense of taste and touch. In small doses it acts as a stimulant, and is said to lessen fatigue. Valuable in eye operations for squint or cataract. Painted in the nostril, it relieves hay fever. Most valuable as an anæsthetic in operations on the throat, rectum, and vagina.

Dr Thorington states that before he commenced using cocaine he lost 50% of his yellow-fever cases; since then he has treated 20 cases and had only 3 deaths, and these 3 patients died of suppression of urine. Our author asserts that when cocaine is used in the treatment of yellow fever, black vomit or vomiting is never a symptom of the disease, and suppression of urine is then the only symptom which need cause anxiety. Even in the latter case he has sometimes seen cocaine act as a diuretic. Before using cocaine the black vomit occurred in nearly all his cases, but now it never appears after this alkaloid has been given, or it rarely fails to check the vomiting and quiet the stomach.

To avoid vomiting when the medicament is administered, it appears best to give it in solution on an empty stomach. Whenever the patient feels nausea returning, a dose of cocaine should be immediately given, even if a preceding dose had been given ¼ hour previously. The author has found it necessary to give thus—½, ⅗, or even 1 gr. every ½ hour, if the vomiting is not checked after the first or second dose of 10 minims of a 4% solution.

COC'CULUS IND'ICUS. *Syn.* INDIAN BERRIES, INDIAN COCKLES, LEVANT NUT, LOUSE GRAINS; BAC'CA ORIENTA'LIS, COCCULUS PISCATOR'IUS, &c., L. The fruit of the *Anamirta cocculus*, a shrub which abounds on the sandy shores of Malabar, and several islands in the Indian Ocean. The kernels should fill at least two thirds of the fruit.

It is a dark, tough, hard, wrinkled berry, about the size of a cherry, and possesses an intensely bitter taste. The berry consists of two parts, the husk and the kernel, the former being hard and difficult to bruise, and the latter soft and containing a large proportion of fatty matter.

Uses, &c. Cocculus indicus is poisonous to all animals, and to most vegetables. It is never employed internally in medicine, but an ointment, formed by mixing the powder with lard, has been used to destroy pediculi and in porrigo. Its active principle is *picro-toxin*, a peculiar needle-shaped, crystalline substance, possessing all the poisonous properties of the berry in an exalted degree, and of which it contains about 1%. Its effects on the system are, to produce giddiness, convulsions, and insensibility, frequently ending in death. A small portion of the cocculus indicus imported is used by poachers, and a still smaller quantity to destroy vermin, the remaining, and by far the greater part, being employed, it is believed, to adulterate beer and even wine. "In our own analytical experience we have seldom found this substance in beer purchased from a respectable house. We have detected it, however, in beers purchased in the lowest localities in London and elsewhere, but have every reason to suspect that the adulterants had been added by the publican himself, in the form of an extract known in the trade by the name of 'B. E.' or black extract" (*Harkness*).

Chemists and druggists are liable to severe penalties if they are found supplying cocculus indicus, or any extract of the same, to brewers or publicans. See BEER, PORTER, &c.

COCH'INEAL. *Syn.* COC'CUS (B. P.), L. GRANA FINA, Span. The *Coccus cacti*, Linn., an insect found upon the cactuses of Mexico, Brazil, and the Canary Islands. It is of great value as a dye-stuff. The female insects, when matured, are brushed off the plants and dried by artificial heat. The entire insect is used. There are two varieties known in commerce—silver cochineal, which has a purplish-grey or silver-grey colour; and black cochineal, which is smaller, and of a reddish or purplish-black colour. The former is that commonly met with.

13,930 *cwts.* of cochineal were imported into England in 1885.

Adult. Genuine cochineal has the sp. gr. 1·25. It is commonly increased in weight by slightly moistening it with gum-water and then rouncing it in a bag, first with sulphate of baryta, and then with finely-powdered bone-black. In this way its sp. gr. is raised to 1·35, in consequence of being loaded by about 12% of useless foreign matter.

Herr Durwell, a German chemist, states that he found a sample of cochineal adulterated with sulphate of zinc. He thinks the sophistication was probably effected by immersing the cochineal in sulphate of zinc, and then in an alkali, whereby the white pulverulent aspect of the genuine article was imparted, and the weight increased.

The following is a method which has been given for estimating the value of samples of cochineal:—Grind the samples to be tested to a fine powder, weigh out 2 or 2½ grms., and boil this amount in a capacious narrow-necked flask, with 750 c.c. of water for 1 hour; filter immediately through dry paper-filters, and allow it to cool. To test it 50 c.c. are measured in a flask of that capacity, and poured into another flask of about 200 c.c., and the measuring vessel rinsed with a definite quantity of water, say 10 to 15 c.c. A weak solution of permanganate is then run in from a burette with a glass cock, the flask being shaken after the addition of every 10 c.c. So much permanganate solution is then added that the cochineal extract shall be changed from its original colour to a pink of the faintest shade—almost yellow, in fact, but never reaching a full yellow. This pink shade should be persistent, that is, it should not turn yellow after standing fifteen minutes; and after a little practice it will be found very easy to obtain the tinge, which shows that the colouring matter is almost but not quite destroyed.

When a number of samples are to be compared, arrange an equal number of 200 c.c. flasks and test-tubes on the table, a tube standing in its rack in front of each flask. Then the same number of c.c. of the permanganate solution (which should be, at least, so weak that bulk for bulk of this and the cochineal solution will be

required) is run into each flask, taking care to use too little to completely destroy the colouring matter in *all*.

The flasks are well shaken and allowed to stand for ten minutes. Part of the contents of each is then poured into the corresponding test-tube, and a glance at the tubes as they stand side by side will show which is the least affected by the bleaching liquid. This sample having been selected to serve as a standard, the contents of the test-tube are returned to the flask, and more permanganate solution is cautiously added, until a very faint pink tinge, which a fraction of a c.c. will turn to a full yellow, is obtained. The number of c.c. used having been noted, a fresh trial is made, in which the c.c. required, minus one, are used, the flask agitated, and the last c.c. or part of it, as the whole may not be necessary, added.

If the two results agree, the next sample is treated in the same way, and so until all are tested.

A final trial may be made by measuring 50 c.c of each solution into its flask, running in the permanganate in the ascertained amount into each as quickly as possible, letting the flasks stand 10 minutes, and then making a comparison of all in the test-tubes. If the shades are not exactly alike, a pretty good guess can generally be made of the fractions of c.c. required, which should be added, the contents of the tubes being joined to that in the flasks, and a second or third comparison thus made.

This is a rather long description of what is in practice a very simple and good process, the three principal points to be borne in mind being:

1st. To use a weak solution of permanganate.

2nd. To have a very faint pink colour as a standard of comparison.

3rd. To let the liquids remain after agitation together 10 or 15 minutes before comparing them.

Uses, &c. Cochineal is principally used to prepare lake and carmine, and in dyeing. Its colouring principle is freely soluble in water. It imparts every variety of scarlet and crimson to textile fabrics previously prepared with alum, tin, and other mordants. It is also used to colour liqueurs, tinctures, and confectionery. It has been recommended as an antispasmodic and anodyne, in hooping-cough and neuralgia.—*Dose*, 10 to 60 gr., in powder, confection, or tincture. See CARMINE and CARMINIC ACID.

COCIN'IC ACID. *Syn.* COCOSTEAR'IC ACID. A crystalline, fatty acid, obtained by the saponification of COCOA-NUT OIL. See STEARIC ACID.

COCK-METAL. *Syn.* POT METAL. Copper, 20 lbs.; lead, 8 lbs.; litharge, 1 oz.; antimony, 3 oz. Another variety consists of copper, lead, and sometimes a little zinc.

COCKROACH. See BLATTA.

CO'COA (kō'-ko). *Syn.* CACA'O. An alimentary substance formed of the roasted seeds of the *Theobroma cacao*, a tree belonging to the Nat. Ord. BYTTNERIACEÆ. This definition is equally applicable to chocolate, but we commonly class the preparations containing sugar and flavouring substances under that head, and the unsweetened and cheap preparations under COCOA. The cocoa-seed or berry must not be confounded with the cocoa-nut, which is the fruit of a palm (*Cocus nucifera*). The cocoa tree is a native of Mexico, and is now more or less extensively grown throughout Central America, Brazil, Peru, Venezuela, Caraccas, Ecuador, Grenada, Demerara, Essequibo, Guayaquil, and Surinam; with some of the West India Islands, foremost among which stands Trinidad, It has also been introduced with more or less success into Africa, the Mauritius, Madagascar. Bourbon, the East Indies, Australia, and the Philippine Islands. The following is a list of the principal kinds of cocoa, in the order of their commercial value:—Caraccas, Surinam, Trinidad, Grenada, Jamaica, Dominica, Guayaquil, Venezuela, Bahia, Brazil, St Lucia. It seems probable that some of the highest kinds of cocoa do not find their way into this country, but are consumed by the inhabitants of Spain.

Theobroma angustifolia, Moc. Sess., is cultivated in Guatemala. It is the Tobasco cacao of the Atlantic slopes of Central America, and probably identical with the celebrated Socunusco cacao of the Pacific slopes. The latter is supposed to be the best cacao known, and little, if any, finds its way into foreign markets.

Prep. The pods containing the seeds are gathered when ripe, and after having lain for a day and a night are opened, and the seeds, which are taken out by hand, are submitted to what is termed the sweating process. They are first placed on a sloping floor or in baskets, so that the chief part of the pulp in which they are enveloped may drain off, and are then shut up in a close box, and left for 24 to 48 hours, according to the season and weather, after which they are turned out in the sun to dry. Upon a nice performance of the sweating process, which may be likened to malting, the value of the cocoa greatly depends. When quite dry, the seeds are packed in barrels or bags, and are ready for shipment. The process of roasting is effected in a metal cylinder, with holes at each end, through which the vapour generated is allow to escape. When the aroma is sufficiently developed the seeds are cooled, and then passed to a 'kibling mill,' which removes the husks and skins from the 'nibs' (see *below*).

Average Composition of Cocoa Seeds. (*Wanklyn.*)

	Per Cent.
Fat (cocoa-butter)	50·00
Albumen, fibrine, and gluten	18·00
Starch	10·00
Gum	8·00
Colouring matter	2·60
Water	6·00
Theobromine	1·50
Ash	3·60
Loss	0·30
	100·00

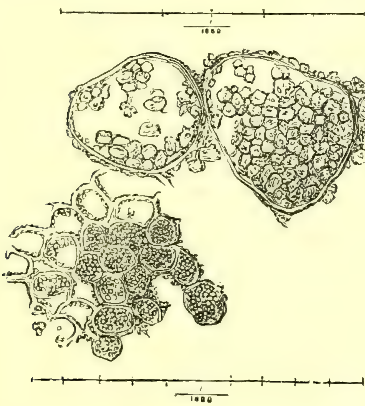
Dr Letheby calculated that a pint of cocoa made with 1 oz. of ground nibs would contain the following proportions of nutritious matters:

Nitrogenous matters	96·2 grains
Fatty matter	218·8 ,,
Gum, sugar, and extractive	65·6 ,,
Mineral matters	17·5 ,,
Total extracted	398·1

Prop., Constituents, &c. Cocoa, when unadulterated, forms a wholesome and highly nutritious beverage. Its active principle is theobromine, an alkaloid greatly resembling caffeine, the active principle of coffee and tea. A peculiar concrete oil, called cocoa-butter, or, more correctly, butter of cacao, is another important constituent, forming more than half the weight of the seed. The presence of about 20% of albumen gives to cocoa its nutritive character.

Adult. Much of the cheap stuff sold as genuine cocoa is shamefully adulterated. Out of 68 samples of cocoa and chocolate examined by the 'Lancet' commission, 39 contained coloured earthy substances, as reddle, Venetian red, umber, &c. To some chalk or plaster of Paris had been added, for the purpose of increasing the weight, and alkali to heighten the colour. Many of the samples consisted of sugar and starch, with only sufficient cocoa to impart a flavour. Cocoas containing a moderate amount of arrowroot or other starch must not be considered adulterated articles, for it is impossible to render cocoa soluble, or rather emulsive, without the addition of some diffusible substance.

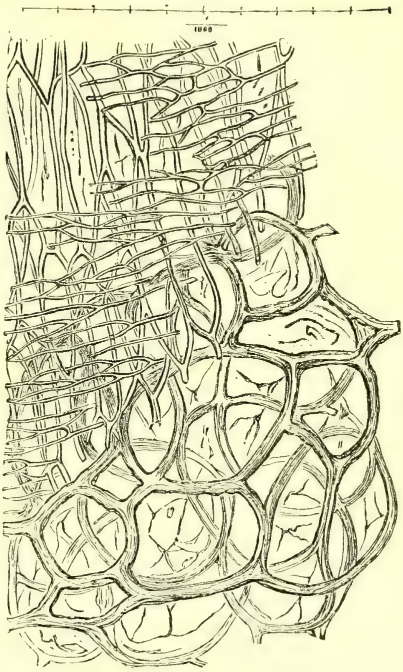
By an examination of the ash the presence of any mineral adulterant may be detected. Mr Blyth says the amounts of ash in genuine cocoa should never exceed 5%. The seed of the cocoa

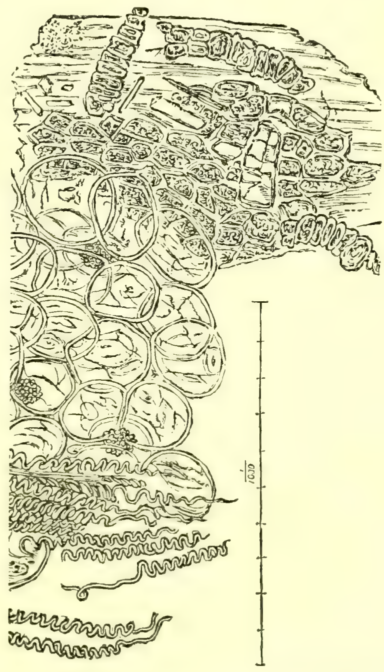


consists of husk and seed proper. Under the microscope the husk exhibits on its surface a number of tubular fibres, filled with granular matter and minute corpuscles. It consists of three membranes; the first being a single layer of elongated cells; the second (forming the chief portion of the husk) of angular cells, enclosing mucilage, and also containing a few spiral vessels and woody fibres. The third membrane is very thin and delicate, and is made up of small angular cells containing minute globules of fat. The seed is composed of minute cells containing starch. The starch-corpuscles are very small, with a trace of inulin. (See *cuts.*)

Cocoa, Flake. This is formed by grinding the nibs in a mill, consisting of two cones, working one inside the other. Pure flake cocoa is not a diluted or amalgamated article; in other words, it contains no sugar, and but a trace of starch.

Cocoa Nibs. The bruised, roasted seeds, freed from husk and membrane. They ought to be of a dull-red or greyish colour, but are frequently





given a bright-red colour by a coating of Venetian red.

Cocoa, Sol'uble. From cocoa nibs and substances which are readily soluble or diffusible in water, ground together. Sugar and sago or arrowroot are the diluents used by respectable makers, but all kinds of starches, coloured with Venetian red, have been used. No form of cocoa is really soluble, but by the addition of easily diffusible substances an article is produced which is capable of forming an emulsion with boiling water. The following are the principal varieties of the so-called soluble cocoa:

1. COCOA, GRANULATED. From cocoa nibs and sufficient sugar and arrowroot to keep the fatty particles from forming a pasty mass. As it is impossible to granulate the nibs without the admixture of some other substance, those makers who declare that their granulated cocoas are perfectly pure do not act honestly towards their customers.

2. COCOA, HOMŒOPATHIC. A kind of soluble cocoa prepared with arrowroot, but without sugar.

3. COCOA, ICELAND-MOSS. From cocoa and Iceland moss, freed from its bitter principle, cetrarine. This form of cocoa was introduced by Messrs Dunn and Hewett, and is said to form a very valuable article of diet for invalids.

4. COCOA, MARAVILLA. This is stated to be 'the perfection of prepared cocoa.' It consists of cocoa, sugar, and sago flour, the last two being in great excess.

5. COCOA, CARACCAS. This is similar to the last, being a mixture of cocoa, sugar, and sago flour. The cocoa used in its manufacture is said to be imported from the Caraccas, on the north coast of South America, and to possess a peculiarly delicious flavour.

The amount of flour or starch in these so-called soluble cocoas frequently exceeds 40%, and the amount of sugar 20%. They have been not inaptly called 'soups.'

In recent years so-called soluble cocoa has been brought into the market. It is sold under various names, thus, 'Theobromine, or Concentrated Cocoa,' 'Cocoa Essence,' 'Cocoatina,' &c.

These cocoas, the preparation of many of which is a trade secret, are pure cocoa deprived of the bulk of its fat and carefully flavoured. They are much more palatable and digestible than the crude article, and though higher in price are more economical in use.

Obs. No warm drink that we take approaches cocoa in its nutritive character, because, while performing to a certain extent the exhilarating work of coffee or tea, it presents to the stomach a very considerable quantity of nitrogenous and carbonaceous matter; this advantage is partly due to the fact that cocoa is taken in the form of an emulsion, instead of an infusion or decoction.

COCOA FOR THE TABLE is readily prepared from the soluble varieties by simply pouring boiling water upon the powder. From cocoa nibs, or flaked cocoa, the beverage is prepared by first pouring boiling water upon them, and then allowing the mass to simmer from 4 to 6 hours. The cocoa must on no account be allowed to boil, for in that case a coagulum will be formed, which cannot be dissolved in water.

COCOA-NUT OIL. A species of vegetable butter obtained from the common cocoa nut—the fruit of *Cocus nucifera*, the cocoa palm. It is separated from the dried kernel by hydraulic pressure. It contains olein, and a solid fat often used as a candle material. 100 nuts yield about 2½ galls. of oil. When first extracted its odour is sweet, but in two days acquires a nasty rancid odour, which perfume will not entirely kill. The natives of most countries producing it use it largely in cookery, also as a pomade. Large plantations of the cocoa palm, connected with Price's candle company, exist in Ceylon. Cocoa-nut oil is often confounded with cocoa- or cacao-butter, which is the produce of a very different plant, namely, *Theobroma cacao*. See COCINIC ACID, COCOA, STEARIC ACID, &c.

COCO PLUM (*Chrysobalanus icaco*, L.). The fruits are about the size of an ordinary plum, and are either white, purple, red, or yellow. They have a sweetish pulp, and are eaten in the West Indies either raw or made into a conserve.

COD. *Syn.* GA'DUS MOR'RHUA (Ph. L.), MOR'RHUA VULGARIS, Linn.; ASEL'LUS, Pliny, L. A fish common in the seas of the Northern Hemisphere, from about 40°—75° of latitude. The flesh forms a most wholesome and excellent article of food. The best fish are very thick about the neck; and, when fresh, are marked by the redness of the gills, freshness of the eyes, and the whiteness and firmness of the flesh. The fish so largely imported from Newfoundland (NEWFOUNDLAND FISH) are cod beheaded, split open, gutted, and salted. They are caught by millions on the 'Grand Bank.' COD-SOUNDS are pickled in brine and also made into isinglass. The spawn is made into CAVIARE, and the liver is both pressed and boiled for its oil (see *below*).

COD IS GENERALLY COOKED by boiling it, but is sometimes baked, or cut into slices and broiled or fried. Cod's head and shoulders with oyster sauce is a favourite dish. Shrimp and anchovy sauce are also good additions.

CODEINA. $C_{18}H_{21}NO_3,H_2O$. *Syn.* MONOMETHYLMORPHINE, CODEINE. An alkaloid discovered by Robiquet associated with morphia. It is usually separated from the ammoniacal liquors from which morphine has been obtained, by evaporating, treating the residue with water, adding caustic potash, collecting the precipitate alkaloid, dissolving in ether, setting aside to crystallise.

Prop., &c. Freely soluble in alcohol and ether; soluble in 80 parts of cold and 24 parts of boiling water. Its solution in the latter, by slow evaporation, yields large transparent octahedra. With the acids it forms crystallisable salts. These possess the singular property of producing a general and violent itching of the surface of the body when administered internally. The same symptoms frequently follow the exhibition of opium and hydrochlorate of morphine, and are referred to the presence of codeia.

Tests. It dissolves in sulphuric acid, forming a colourless solution which, when gently warmed with molybdate of ammonia, or a trace of ferric chloride, assumes a deep blue colour. Unlike morphine, it is insoluble in weak solution of potash, and is soluble in ether. The salts of codeine are

known by tincture of galls throwing down a copious precipitate from their solutions; this does not occur with the salts of morphine. It is distinguished from meconine by its aqueous solution showing an alkaline reaction with test-paper.

Uses. Given with benefit in diabetes, as it reduces the amount of sugar in the urine.—*Dose,* ½—2 grains.

COD-LIVER OIL. *Syn.* MOR'RHUÆ O'LEUM, B. P.; OLEUM JECOR'IS ASEL'LI, L.; HUILE DE MORUE, FR. The oil obtained from the liver of the common cod, *Gadus morrhua.*

The seat of the Norwegian cod-fishery is the Lofoten Islands. The fish begin to arrive in December, and remain for spawning purposes till March. The fish are taken with hand lines, set lines, and with nets. As soon as the fish are brought on shore the livers are removed and carefully examined, and those that are poor, have sustained injury, or have portions of gall adhering are removed.—*Prep.* 1. Having washed the livers, they are now placed in open barrels, when the oil slowly exudes, rising to the surface to be skimmed off. It is finally filtered 3 or 4 times. This oil is described as of a straw-colour, has little taste or smell, and is known as natural medicinal oil. Some makers use the heat of a water or steam bath to extract the oil. The residual livers are usually boiled down, giving a further yield of dark brown, or tanner's oil.

At Lofoten, much care is exercised in using only the livers of the cod; but all along the Norway coast an inferior dark kind of oil is made indiscriminately from the livers of cod, coalfish, ling, haddock, and skate, and even of the shark.

The sooner cod-liver oil is bottled after it is made, the better is it preserved from rancidity; the bottles should be completely filled, so as to exclude air.

2. (*Savory.*) The livers taken from the fresh fish are carefully washed. The large veins are then divided through their whole length, and any blood in them is carefully rinsed away. The livers are now cut into pieces, again washed and drained, and afterwards placed with a small quantity of water in vessels gently heated by steam. As the heat increases, the oil separates and rises to the surface, from which it is skimmed off; and after well cooling, to allow the deposit of some of the margarine, it is repeatedly filtered through flannel bags, and finally through paper. This process gives a fine, clear, straw-coloured oil, having but a slight smell and taste.

Obs. Three kinds of cod-liver oil are usually distinguished—the pale yellow, pale brown, and dark brown. The latter is the most impure; its odour and taste are extremely disagreeable. The most conflicting opinions have been expressed by medical men as to the relative value of the light brown and yellow varieties. Ozonised cod-liver oil is said to be prepared by passing oxygen into the oil, and then exposing it to sunlight. Dr Letheby applied the most delicate tests to this much-vaunted remedy, but was not able to detect the slightest trace of ozone.

Prop. and Uses. Cod-liver oil has acquired much reputation for its remedial powers in pulmonary consumption, scrofulous and other glandular affections, chronic gout and rheumatism, certain skin diseases, and several other ailments. It is generally supposed that the iodine and bromine, which are present in minute quantities in this fish, are the substances to which it owes its efficacy. Dr De Jongh refers its virtues to the presence of both iodine and the elements of the bile.—*Dose,* 1 to 4 dr.

To mask the fishy taste of cod-liver oil, and enable patients better to retain it on the stomach, many suggestions have been made, amongst which the following are worthy of mention. A pinch of salt before or after the dose, or a piece of salt herring; 10 drops of ether with each dose; 5 drops of essential oil of almonds to the ½ pint disguises the odour, and gives an almond flavour. It may be floated on milk, orange wine, or weak brandy.

M. Duquesnel states that cod-liver oil flavoured with essence of eucalyptol, in the proportion of 1 part of the essence to 1000, has neither the taste nor the odour of cod-liver oil. It is taken with facility, only leaving at the back of the mouth and on the tongue the taste of the essence. M. Duquesnel adds that the offensive eructations arising from cod-liver oil are completely corrected.

Cod-liver Oil Jelly. Take of cod-liver oil, 85 parts; isinglass, 3 parts; sugar, 8 parts; water, 4 parts. It forms a semi-transparent jelly of a yellowish-green colour, having a strong odour, but less strong taste of the oil. The advantages of this preparation are—its easy administration, complete retention and assimilation by the weakest stomach. A teaspoonful is said to be equal to a tablespoonful of the ordinary oil. A lemon flavour may be imparted to it with advantage if desired.

Cod-liver Oil and Lacto-Phosphate of Lime. (*Shinn.*) Cod-liver oil, 1 pint; oil of bitter almonds, peppermint, and winter green, of each, 10 drops; powder of gum-arabic, 4 oz.; sugar, 6 oz.; solution of lacto-phosphate of lime (60 gr. to 1 fl. oz.), 6½ fl. oz.; lime water, 6½ fl. oz. Mix the gum and sugar in a capacious mortar, and make a smooth mucilage with the lime water, and 3 oz. of the solution of lacto-phosphate of lime. Add the volatile oils to the cod-liver oil, and gradually triturate them with the mucilage, until a perfect emulsion is formed. Finally, add the rest of the solution of the lacto-phosphate of lime, and mix thoroughly. The solution of lacto-phosphate of lime is made by saturating a solution of lactic acid with freshly precipitated phosphate of lime.

Cod-liver Oil with Iodide of Iron. Triturate iodide of iron with cod-liver oil, 4 gr. to the oz., until dissolved. HORSLEY's patent is as follows: Dissolve 22 scruples of iodine in a gallon of cod-liver oil, at a temperature of 140° F., in a water-bath. Add to the solution 8 scruples of iron (reduced by hydrogen), and heat to 180° F., until the combination is complete.—*Dose,* 1 dr. to ½ oz.

Cod-liver Oil, Phosphorated. ('Lancet.') Pure unoxidised phosphorus, 2 gr.; almond oil, 2 oz. Put into a bottle, stoppered, and immerse the same in a water-bath; apply heat until the temperature of the oil is about 180° F., as directed by the B. P. in the preparation of *oleum phos-*

phoratum; shake up occasionally, and again put the bottle into the water if necessary, until a perfect solution is obtained; then add about 10 oz. of cod-liver oil, and again immerse in the water-bath; finally, make up the measure with cod-liver oil to 25 oz. One drachm so prepared will contain over the $\frac{1}{100}$ of a grain of pure phosphorus.

Cod-liver Oil and Hypophosphites, Emulsion of. (Canadian 'Pharmaceutical Journal.') Powder of gum tragacanth, ½ oz.; glycerine, 3 oz.; water, 9 oz. Rub the tragacanth with the glycerine, and add the water gradually. To this mucilage add the following solution: Hypophosphite of lime, 4½ dr.; hypophosphite of soda, 2¼ dr.; hypophosphite of potash, 2¼ dr.; sugar, ¾ lb.; boiling water, 12 oz. Make the admixture gradually with brisk trituration. To this medicated mucilage add the following: Otto of almonds, bitter, 10 drops; otto of cinnamon, 5 drops; otto of canella, 5 drops; alcohol, 6 oz. The whole will now form a semi-transparent mucilaginous liquid of about 37 fl. oz. in bulk. To this add gradually an equal measure of cod-liver oil, and mix thoroughly. In practice it is advisable to work on small quantities, say ½ pint of each in a No. 8 mortar. If care is taken the product will be very satisfactory.

Emulsion of Cod-liver Oil. (Unofficial Formulary.) Cod-liver oil, 8 oz.; yelks of 2 eggs; tragacanth powder, 16 grs.; elixir of saccharin, 1 dr.; simple tincture of benzoin, 1 dr.; spirit of chloroform, 4 dr.; essential oil of almonds, 8 minims; distilled water to produce 16 oz. Measure 5 fl. oz. of the distilled water, place the tragacanth in powder in a dry mortar, and triturate with a little of the cod-liver oil; then add the yelks of the eggs; stir briskly, add water as the mixture thickens. When of a suitable consistence add the remainder of the oil and water with constant stirring. Transfer to a pint bottle, add the elixir, tincture, spirit, and essential oil; shake well, and add water to make the product measure 16 oz.

Emulsion of Cod-liver Oil. (*Gerrard.*) Cod-liver oil, 4 oz.; powdered gum acacia, 1 oz.; oil of cassia, 4 minims; essential oil of almonds, 4 minims; saccharin, 2 gr.; water to make 8 oz. Mix the oils with the gum and saccharin in a dry mortar; add 2 oz. of water in 1 volume, stirring till the emulsion is formed; finally, add sufficient water to make 8 oz.

COFFEE. The seeds or berries of the *Coffea arabica*, Linn., or coffee plant; a shrub of the Nat. Ord. CINCHONACEÆ, sub-order COFFEÆ, indigenous in the low mountainous districts of Arabia Felix, and largely cultivated in various other parts of the world. About 40 millions of lbs. of coffee are annually consumed in this country, and the consumption for the whole world has been estimated at about 600 millions of lbs. The seeds are roasted and ground, and used as a decoction or infusion. The term of coffee is applied to the prepared beverage as well as to the seeds. The valuable properties of coffee are mainly due to the presence of the alkaloid CAFFEINA or CAFFEINE. LIBERIAN COFFEE (*Coffea liberica*, Bull and Hiern), a glabrous shrub, native of Liberia, has been introduced into many coffee-growing countries, in consequence of its more robust habit than the *Coffea arabica.* The beans are much larger, and it thrives at lower elevations.

Payen gives the following as the composition of the coffee-berry:

Water	12·000
Woody tissue	34·000
Fixed fatty matters	10 to 13·000
Gum, sugar, and vegetable acids	15·500
Nitrogenous matter allied to legumin (vegetable casein)	13·000
Free caffeine	0·800
Compound of caffeine with potash	35 to 5·000
Solid fatty essence	0·002
Aromatic essential oil	0·001
Saline matters	6·697
	100·000

Prep., &c. The finest kind of coffee is that called Mocha, from Aden, but that in common use is principally supplied from the British plantations in the West Indies. The fruit of the coffee tree, which resembles a cherry in size and colour, contains two seeds (beans), which are separated by mechanical means from the pulp. After fermentation and washing, the seeds pass through a rolling-mill, which removes the parchment-like husk and silver skin immediately enclosing the seeds. The commercial value depends on the size, form, and colour of the beans, and their flavour. Pearl coffee is that in which the berry instead of bearing two seeds has only one, which consequently takes a rounded form; a proportion of pearl coffee is produced in every crop. TRIAGE consists of the damaged and broken beans which, though not of so good an appearance, are equal in quality to the other kinds of coffee. The selection being made, the berries are carefully roasted in revolving cylinders by a gradually applied heat, until the aroma is well developed and the toughness destroyed. Too much heat is avoided, as the volatile and aromatic properties of the coffee, and, consequently, the flavour, are thereby injured; whilst, on the other hand, if the berries are roasted too little, they produce a beverage with a raw, green taste, very liable to induce sickness and vomiting. When properly roasted, coffee has a lively chocolate-brown colour, and should not have lost more than 18% of its weight by the process. If the loss exceeds 20%, the flavour suffers in proportion. The roasted coffee should be placed in a very dry situation, and excluded from the air as soon as possible. It loses flavour by keeping, and also powerfully absorbs the moisture from the atmosphere by reason of its hygroscopic power.

Qual., &c. Coffee promotes digestion and exhilarates the spirits, and when strong, generally occasions wakefulness, but in some phlegmatic constitutions induces sleep. Drunk in moderation, especially if combined with sugar and milk, it is perhaps the most wholesome beverage known. The various qualities that have been ascribed to it by some persons, such as dispelling or causing flatulency, removing dizziness of the head, attenuating the blood, causing biliousness, &c., appear to be wholly imaginary. From a medical point of view it has been regarded as a cerebral stimu-

lant and antisoporific, and as a corrector of opium. As a medicine it should be strong, and is best taken only lukewarm.

Adult., &c. The principal substances used for the purposes of adulteration are caramel, roasted chicory, roasted locust beans, roasted corn, &c. Chicory now being charged with the same amount of duty as coffee, it is not considered in a revenue point of view an adulteration; nevertheless, when we contrast coffee with chicory, we at once see the vast superiority of the former over the latter, thus:

Coffee is the fruit of a tree, whilst chicory is the root of an herbaceous plant, and it is well known that more virtues exist in fruits and seeds than in roots.

Coffee contains three active principles, viz. an essential oil, caffeine, and tannic acid; and these exercise a powerful influence on the system, retarding the waste of the tissues of the body, exciting the brain to increased activity, and exhilarating without intoxicating. Chicory contains none of these constituents.

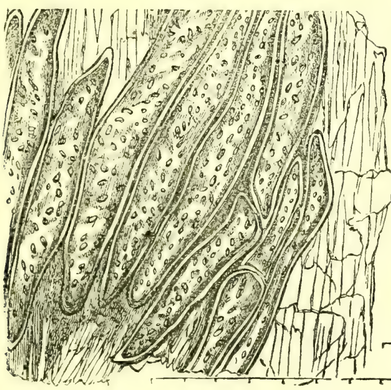
Coffee exerts on the system highly beneficial physiological effects; chicory possesses medicinal properties which are not desirable in an article of food.

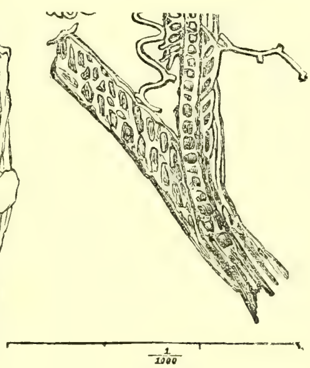
Chicory, therefore, is very objectionable, and when a dealer sells a mixture of coffee and chicory for pure coffee, as is almost invariably the case, he is guilty of selling an adulterated article, and ought to be punished accordingly.

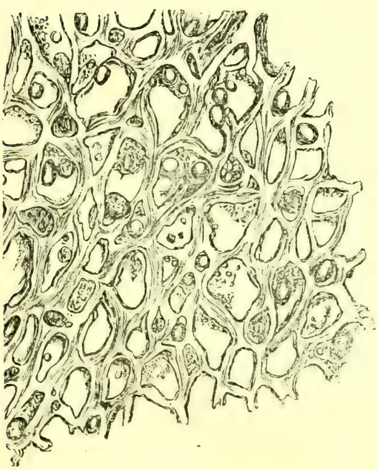
The adulteration with caramel or chicory may readily be detected as follows:

1. A spoonful of pure coffee placed gently on the surface of a glass of cold water will float for some time, and scarcely colour the liquid; if it contains caramel or chicory, it will rapidly absorb the water, and, sinking to the bottom of the glass, communicate a reddish-brown tint as it falls. Another method of applying this test is by expertly shaking a spoonful of the suspected coffee with a wine-glass of cold water, and then placing the glass upon the table. If it is pure, it will rise to the surface, and scarcely colour the liquid; but if caramel or chicory is present, it will sink to the bottom, and the water will be tinged of a deep red as before.

2. The brown colour of decoction or infusion of roasted coffee becomes greenish when treated with a per-salt of iron, and a brownish-green flocculent precipitate is formed. The colour of chicory is only deepened, but not otherwise altered, and no precipitate is formed under the same treatment. A mixture of chicory and coffee







retains a brownish-yellow colour after the precipitate has subsided, and the liquid appears brownish yellow by refracted light. The addition of a little weak ammonia water aids the subsidence of the precipitate.

3. Under the microscope (see CHICORY) the presence of chicory may be readily detected by the size, form, and ready separation of the cells of the cellular tissue, and by the presence and abundance of the pitted tissue or dotted ducts, which are absent from coffee, and by the size of the spiral vessels, which are very small in coffee. The most characteristic structure, however, and that by which chicory can be easily identified, is the lactiferous tissue. Roasted corn, and other amylaceous substances, may also be detected, in the same way, by the peculiar size and character of their starch grains.

Under the microscope the berry is seen to consist of a hard, tough tissue, that resists even long soaking. The testa covering the berry is made of lengthened cells with oblique markings resting

on a thin membrane, almost structureless. These oblique markings of the cells are so characteristic as to render the cells distinguishable from every other tissue. The substance of the berry consists of angular cells, each one of which contains minute drops of oil. This oil is in some measure driven off during the process of roasting, which, however, leaves the structure unimpaired where it is not charred.

Roasted corn, beans, &c., may be detected by the cold decoction striking a blue colour with tincture of iodine. Pure coffee is merely deepened a little in colour by this substance.

4. (*A. H. Allen.*) The amount of ash in genuine coffee does not exceed 4·5% ; chicory yields 5 per cent. The silica in coffee ash never exceeds 1%, while in chicory it varies from 10% to 36%. The average soluble ash in coffee is 3·24%, while in chicory it is 1·74%. By determining the soluble ash S, the percentage of pure coffee C may be calculated thus:

$$C = 2\left(\frac{100\ S - 174}{3}\right)$$

The density of coffee-infusion is determined by heating the powder with 10 times its weight of cold water, raising the liquid to the boiling-point, filtering, and taking the gravity at 15·5° C. Taking the density of pure coffee-infusion at 1008·6, and that of chicory at 1020·6, the percentage of pure coffee C in the sample may be calculated from the equation

$$C = \frac{100(1020 - D)}{12}$$

where D represents the density of the infused sample. The relative tinctorial power of an infusion of a sample of coffee is determined by boiling a given weight with 20 c.c. of water for a few minutes, filtering, and again boiling the residue until thoroughly exhausted. An equal weight of a standard mixture of equal weights of pure coffee and chicory is treated in a precisely similar manner. The standard solution is made up to 200 c.c., that of the sample to 100 c.c.; 10 c.c. of the latter are put into a narrow burette, and some of the standard into a test-tube of exactly equal bore. If the tints are exactly the same, the sample consisted of pure coffee; if chicory is present, water must be added to the sample until the tints are the same. Each c.c. of water represents 5% of chicory. The presence of leguminous seeds or cereals may be detected by boiling the sample with animal charcoal and water, filtering, and testing for starch in the cold liquid with iodine. Neither coffee nor chicory contains starch.

Obs. A few years ago the attention of the scientific world was drawn to the value of roasted coffee leaves, as furnishing materials for a beverage unexcelled in excellence by the coffee-berry itself. It appears that the leaves, prepared for use, may be purchased for 1½*d.* per lb., or packed ready for export at 2*d.* per lb. "That this preparation contains a considerable amount of the nutritious principles of coffee is evident from the analysis; but as the leaves can only be collected in a good state at the expense of the coffee-bush, it is doubtful whether the coffees produced by the berries be not after all the cheapest, as it certainly is the best" ('Jury Report,' Exhibition, 1851). Coffee for the table is best prepared with the aid of a French *cafetière*, or coffee-biggin, furnished with a percolator or strainer, which will permit a moderately rapid filtration. To produce this beverage in perfection, it is necessary to employ the best materials in its preparation—fresh roasted and fresh ground. "At least 1 oz. of coffee should be used to make 3 common-sized coffee-cupfuls, with 1 teaspoonful of freshly roasted and ground chicory. If desired strong, the quantity of both should be doubled" (*Cooley*). Many habitual coffee-drinkers cannot tolerate the use of chicory, which is a doubtful improver of coffee. The prevailing fault of the coffee made in England is its want of strength and flavour. The coffee-pot should be heated previously to putting in the coffee, which may be done by means of a little boiling water. The common practice of boiling coffee is quite unnecessary, for all its flavour and aroma is readily extracted by boiling hot water. Indeed, all the "useful and agreeable matter in coffee is very soluble; it comes off with the first waters of infusion, and needs no boiling" (*Ure*). Should prejudice, however, induce the housewife or cook to boil her coffee, it should be only just simmered for a minute, as long or violent boiling injures it considerably.

When coffee is prepared in a common pot, the latter being first made hot, the boiling water should be poured over the powder, and not, as is commonly the plan, put in first. It should then be kept stirred for 4 or 5 minutes, when a cup should be poured out and returned again, and this operation repeated 3 or 4 times, after which, if allowed to repose for a few minutes, it will generally become fine of itself. In all cases where a percolator is not used, the liquor should be well stirred up several times before finally covering it up to settle for use.

Amongst the various descriptions of coffee-pots in use we may mention those of French make, consisting of two cylindrical vessels, the upper having a metal strainer, on which the ground coffee is placed, and through which the clear infusion runs into the lower one; Loysell's, an apparatus making very good coffee, and as one of the latest, an ingenious and inexpensive coffee-pot, known as the 'Kaffee Kanne,' devised by Mr Ash, of Oxford Street. Ash's 'Kaffee Kanne' consists of an ordinary biggin, surrounded by a jacket containing boiling water. The coffee is made by percolation in the inner vessel, and, being kept at the point of ebullition by the surrounding boiling water, yields a beverage of excellent flavour and aroma.

Coffee is sometimes clarified by adding a shred of isinglass, a small piece of clean eel- or sole-skin, or a spoonful of white of egg. An excellent plan, common in France, is to place the vessel containing the made coffee upon the hearth, and to sprinkle over its surface half a cupful of cold water, which from its greater gravity descends, and carries the 'foulness' with it. Another plan sometimes adopted is to wrap a cloth, previously dipped into cold water, round the coffee-pot. This method is commonly practised by the Ara-

bians in the neighbourhood of Yemen and Moka, and rapidly clarifies the liquor, unless a very large quantity of chicory is present. It should be recollected that the use of isinglass, white of egg, and all like artificial finings remove much of the astringency and vivacity of the liquor.

The French, who are remarkable for the superior quality of their coffee, generally allow an ounce to each large coffee-cupful of water, and they use the coffee both newly ground and freshly roasted. A shred of saffron or a little vanilla is frequently added, whilst the percolating coffee-pot is generally employed. When the Parisian uses a common coffee-pot, he generally divides the water into 2 parts. The first portion he pours on boiling hot, and allows it to infuse for 4 or 5 minutes; he then pours this off as clear as possible, and boils the grounds for 2 or 3 minutes with the remaining half of the water. As soon as this has deposited the sediment it is decanted, and mixed with the infusion. The object of this process is to obtain the whole of the strength as well as the flavour. The infusion is thought to contain the latter, and the decoction the former; a plausible but erroneous idea, since both of them were carried off by the first water.

A much better method, and one we can recommend from experience, is to divide the coffee into 2 parts. Boil the first portion in the coffee-pot for 4 or 5 minutes, then add the other portion, and allow it to infuse slowly for about 10 minutes, the coffee-pot lid being kept well closed. This gives a coffee possessing a flavour which even the French cannot excel.

Coffee, Essence of. A highly concentrated infusion of coffee, prepared by percolation with boiling water, gently and quickly evaporated to about 1-3rd or 1-4th of its bulk, and mixed with a thick aqueous extract of chicory and syrup of burnt sugar, so as to give the whole the consistence of treacle. The proportions of the dry ingredients should be—coffee, 4 parts; chicory, 2 parts; burnt sugar (caramel), 1 part. It should be kept in well-corked bottles in a cool place. This preparation is very convenient for making extemporaneous coffee; but the beverage so made, though superior to much of that sold at coffee-houses, is inferior in flavour, aroma, and piquancy to that we are accustomed to drink at home. Much of the so-called 'Essence of Coffee' is simply treacle and burnt sugar, flavoured with coffee.

Coffee, Searle's Patent. This is prepared by mixing condensed milk with a very concentrated essence of coffee and evaporating at a low temperature (*in vacuo*, if possible), until the mixture acquires the consistence of a syrup (coffee syrup), paste (coffee paste), or candy (coffee candy). The last may be powdered (coffee powder, dry essence of coffee).

Coffee, Substitutes for. These are numerous, but are now seldom employed, owing to the cheapness of the genuine article and the stringency of the revenue laws. Among the principal are the following:

1. Coffee, Acorn. From acorns deprived of their shells, husked, dried, and roasted.

2. Coffee, Bean. Horse-beans roasted along with a little honey or sugar.

3. Coffee, Beet-root. From the yellow beet-root, sliced, dried in a kiln or oven, and ground with a little coffee.

4. Coffee, Dandelion. From dandelion roots, sliced, dried, roasted, and ground with a little caramel.

5. Coffee, German. *Syn.* Succory c., Chicory c. From chicory or succory. Used both for foreign coffee, and to adulterate it.

6. Café de Soudan, the seeds of *Parkia biglobosa*, Benth., when roasted, are used as a substitute for coffee and chocolate; the tree was long supposed to be identical with Cola.

Obs. All the above are roasted, before grinding them, with a little fat or lard. Those which are larger than coffee-berries are cut into small slices before being roasted. They possess none of the exhilarating properties or medicinal virtues of foreign coffee, but are sometimes invaluable to the traveller where the water is doubtful. The drink is palatable, and, being boiled, the water used is rendered more or less harmless.

COKE. Charred or carbonised coal. It has a greyish colour, and an almost metallic lustre. Its properties depend upon the coal employed in its manufacture, and the method of carbonisation adopted. The higher the temperature used, the harder and denser is the coke; it contains from 85% to 92% of carbon, 3% to 5% of ash, and 5% to 10% of water, which it absorbs when exposed to the air. On combustion, it produces less heat by 1-5th than an equal weight of wood-charcoal. Coke takes fire only at a high temperature, and continues to burn only in a quick current of air.

Prep. This is similar to that of wood-charcoal. The coal may be burnt in stacks, but this is an extremely wasteful method. The usual plan is to effect the carbonisation in ovens, or in retorts, and to make use of the gaseous products which escape. When ovens are employed, the gas evolved is used to drive steam engines by its combustion, or to heat the coke-oven itself. The best coke-ovens furnish about 12 tons of coke a day. The largest quantity of coke is formed as a by-product in the manufacture of coal-gas, as the cinder left in the gas retorts; it is much used in furnaces for heating apartments by hot air or hot water, and in immense quantities in metallurgical operations. It produces a higher temperature than coal by its combustion, and has the advantage of containing but a small quantity of sulphur.

The blue flame seen at the top of a clear coke fire is caused by the combustion of the carbon monoxide, CO, formed by the reduction of the carbon dioxide which is produced at the lower part of the furnace.

COLCHICIN'A. *Syn.* Col'chicine, Colchicina. A peculiar principle discovered by Gieger and Hesse in the seeds of the *Colchicum autumnale*, or common meadow saffron. It also exists in the corms or bulbs.

Prep. Macerate the bruised seeds in boiling alcohol, add magnesia, to throw down the alkaloid, digest the precipitate in boiling alcohol, and filter. By cautious evaporation colchicine will be deposited, and may be purified by re-solution and crystallisation in alcohol.

Prop., &c. Odourless; bitter; soluble in water

and alcohol. It is very poisonous. 1-10th of a grain, dissolved in spirit, killed a cat in 12 hours. It differs from veratrine in being soluble in water and crystalline, and in the non-production of sneezing when cautiously applied to the nose. Strong oil of vitriol turns it of a yellowish-brown; nitric acid turns it of a deep violet, passing into indigo-blue, green, and yellow. It is not used in *medicine*.

COL'CHICUM. *Syn.* MEADOW SAF'FRON; COLCHICUM AUTUMNALE, Linn., L. The recent and dried corms or bulbs (*Colchici cormus*), as well as the seeds (*Colchici semina*), are official in the British Pharmacopœia. The corms are ordered to be dug up in the month of July, or before the autumnal bud has projected. The dry coatings having been torn off, cut the corms transversely in thin slices, and dry, at first with a gentle heat, but afterwards slowly increased to 150° F.

Dose (of the corms), 2 to 8 or 9 gr.; (of the seeds), 2 to 7 gr., made into a pill or bolus with syrup or conserve; chiefly as a specific in gout, to alleviate or check the paroxysm. This drug forms the base of almost all the advertised gout nostrums. It is, however, an active poison, and its administration requires care. "After all that has been said respecting colchicum in gout, and admitting that it rarely fails to allay pain and check a paroxysm, I would record my opinion that he who would wish to arrive at a good old age should eschew it as an *ordinary* remedy, and consider that he is drawing on his constitution for a temporary relief, with a certainty of becoming prematurely bankrupt in his vital energies" (*Collier*).

Antidotes. An emetic consisting of 1 scruple of sulphate of zinc dissolved in water, followed by a brisk dose of castor oil, then stimulants, and also charcoal.

COL'COTHAR. See OXIDES OF IRON.

COLD. *Syn.* FRI'GUS, L. The privation of heat. The term is also applied in the sensation and effects which this privation produces.

When the body of an animal is immersed in an atmosphere at a temperature below the healthy standard, a sensation of coldness is experienced, produced by the passage of the heat of the body into the colder medium. If this extraction of heat exceeds the quantity produced by the organism, the temperature of the body decreases, until it sinks below the point at which the functions of life can be performed. This declination of the heat of the body is gradual; the extreme sensation of coldness is followed by numbness and a diminution of muscular activity, and power, and the individual becomes incapable of supporting himself; the propensity for sleep becomes irresistible; the senses are confused, the ideas incoherent, and a species of delirium comes on. This is especially the case at high altitudes where the reduced atmospheric pressure contributes powerfully to the upsetting of the normal balance. The desire for rest and sleep, and the obstinate refusal of the patient to realise the gravity of his situation; his placid contentment and resignation are grave signs, and to be combated by the most urgent means. Persons liable to '*mal de montagne*' should not take part in alpine excursions, as they not only risk their own lives, but imperil those of their companions. If the effect of cold continue, the respiration and circulation become enfeebled, and coma ensues, indicating the approach of death.

The prevention of the effects of cold consists in the use of ample food and clothing proportioned to the inclemency of the weather, the exposure to be endured, and the habits of the wearer. The circulation of the blood should be promoted by active exercise, and any disposition to sleep shaken off by increased bodily exertion. The principal endeavour should be to keep the extremities and chest warm, as, if this can be accomplished, no danger need be feared.

Treatm. This must, in all cases, be gradual and careful, especially if the patient have been long exposed. He should be stripped and placed in the recumbent position in a room, the air of which is dry, still, and cold; but capable of being gradually warmed. The whole surface of the body should be gently rubbed, care being taken not to injure the rigid or frozen parts, by rough handling. The cold bath, gradually raised in temperature, is an excellent means, when available, of restoring the patient. When the sufferer can swallow, tea, coffee, beef tea, and soup should be cautiously given, and later *small quantities* of alcohol, which, though utterly useless, if not positively injurious if taken to *fortify against* cold, is useful in removing the effects when administered with care. As in the case of the drowned or suffocated, no efforts should be spared to restore animation; and as it is often difficult to determine whether life be extinct or no, these efforts should be persisted in. The greatest possible care should be taken of the patient when restored to life and for a long time after. Rest, good food, and tonics are indicated.

COLD CREAM. A snow-white, bland ointment, about the consistence of good lard, and an admirable substitute for that excipient where expense is no object, especially for applications about the face. It is commonly sold as a lip-salve, and as a healing application to abraded and chapped surfaces generally. The following produces a superior article.

Prep. (*Dr L. Turnbull.*) 1. From white wax, 1 oz.; oil of olmonds, 4 oz.; rose-water, 2 oz.; borax, ½ dr.; oil of roses, 5 drops. Melt, and dissolve the wax in the oil of almonds by a gentle heat; dissolve the borax in the rose-water, which is then to be warmed a little and added to the heated oil; lastly, add the oil of roses, stirred.

2. Cetacei, 10½ oz.; ceræ alb., 10½ oz.; ol. amygd. pallid., 48 oz.; aq. rosæ, 16 oz.; ess. bergam., 4 dr. or q. s.; otto rosæ, 4 dr. or q. s.; acid. salicylic., 160 gr.

Vaseline Cold Cream. 1. White vaseline, 1 lb.; spermaceti, 2 oz.; hard paraffin, 2 oz.; almond oil, 4 oz.; elderflower water, 6 oz.; otto of rose, 8 drops. Melt the spermaceti and paraffin, add the almond oil and half of the vaseline, and when the whole is liquefied transfer to a warm mortar; now add the rest of the vaseline and incorporate the water and otto in the usual way.

2. White wax, 2½ oz.; spermaceti, 2½ oz.; oil of almonds, 14½ oz.; white vaseline, 6½ oz.; distilled water, 6½ oz.; borax, 150 gr.; coumarin, ¾ gr.; oil of rose, 16 drops; oil of bergamot, 16 drops; oil of

geranium, French, 5 drops; oil of rhodium, 2 drops; oil of orris, 1 drop; essence of civet (1 : 10), 5 drops. Melt the wax, spermaceti, and vaseline in the almond oil, allow the melted mass to cool to a semi-liquid state, and beat it to a cream. Then add the distilled water in which the borax had previously been dissolved, and finally add the perfumes, stirring constantly so as to produce a uniform cream.

Almond Cream. Vaselini alb., 7 oz.; ceræ alb., ½ dr.; cetacei, 6 dr. Melt, when nearly cold, add aq., 3 oz.; p. boracis, ½ dr. Stir, and add ol. amygd. ess., q. s. Tinge delicate pink, with ammoniacal solution of carmine.

In the following formula Maercker, a German pharmacist, gives nut oil (ol. arachis) the old place of almond oil, thereby producing a cheaper article:—White wax, 4 parts; spermaceti, 5 parts; nut oil, 23 parts. Melt on a water-bath, and, having removed from the bath, stir diligently, and add another 4 parts of nut oil, then 16 parts of rose water containing 1-6th part of borax dissolved in it. Finally perfume with a drop of otto of roses to every 2 oz. (or less) of the cold cream.

COL'IC. *Syn.* COLI'CA, L. The belly-ache, or gripes. The name is popularly given to all severe griping abdominal pains, without reference to the cause. There are several varieties of this disease, as noticed below.

Colic, Accident'al. Produced by improper food and poisons. The treatment may be similar to that recommended for bilious or flatulent colic.

Colic, Bil'ious. In this variety the pain is intermittent and transient, accompanied by constipation, nausea, and vomiting. The fæces, if any, are bilious, dark-coloured and offensive. The common remedies are, a full dose of blue pill, calomel, colocynth, or aloes, followed by a sufficient quantity of Epsom salts or Glauber's salts. Warm fomentations are also serviceable.

Colic, Flat'ulent. Marked by constipation and the irregular distension of the bowels by gas, accompanied by a rumbling noise, &c. It is commonly produced by the use of indigestible vegetables and slops. The remedies are, a full dose of tincture of rhubarb combined with a few drops of essence of peppermint. When the pain is extreme, warm fomentations, linseed or mustard poultices to the belly, or a carminative clyster, will generally give relief. Opium is often of great service in relieving the acute pain. With small children and old people care must be exercised in the use of remedies, as damage to the bowels, intussusception, and inflammation may ensue; the possibility of obstruction must always be borne in mind.

Colic, Paint'ers'. *Syn.* PLUMB'ERS' COLIC, DEVONSHIRE C., LEAD C.; COL'ICA PICTO'NUM, L. The dry belly-ache. It is marked by obstinate costiveness, acrid bilious vomitings, violent pains about the region of the navel, convulsive spasms in the intestines, and a tendency to paralysis in the extremities. It is most prevalent in the cider counties, and amongst persons exposed to the fumes of lead. The remedies are the same as for the spasmodic variety. Should these fail, after the bowels have been thoroughly evacuated, small doses of camphor and opium may be administered, and sulphuric beer or sweetened water very slightly acidulated with sulphuric acid, had recourse to as a beverage. Mr Benson, the managing director of the British White-lead Works at Birmingham, says, "Although during several weeks after the addition of the sulphuric acid to the treacle beer, drank at the works, little advantage seemed to be derived, yet the cases of lead colic became gradually less frequent, and since October of that year, or during a period of 15 months, not a single case of lead colic has occurred amongst the people" ('Lancet.') See BEER, SULPHURIC ACID, and SULPHURIC ACID.

Colic, Spasmod'ic. Marked by a fluctuating pain about the navel, which goes away and returns by starts, often leaving the patient for some time. The belly is usually soft, and the intestines may often be felt in lumps, which move about under the hand, or are wholly absent for a time. It is unaccompanied by flatulency. The remedies are warm fomentations, warm clysters, and carminatives, accompanied by small doses of camphor and opium.

Colic, Stercora'ceous. Marked by severe griping pains and constipation of the bowels. The remedies are powerful cathartics, as full doses of calomel, aloes, colocynth, jalap, &c., followed by purgative salts, as sulphate of magnesia, or sulphate of soda.

Colic in Horses. Mr Gamgee's treatment of SPASMODIC COLIC in horses is based on the very rational assumption that it is caused by some offending material in the bowel, the removal of which will cause the subsidence of the symptoms. He therefore gives cathartics (a ball containing 5 to 10 dr. of aloes, according to the size of the animal and the nature of its food), and enemata of warm water only. Except in special cases, opiates should not be used when 1 oz. or 2 oz. of tinct. opii may be given in warm water. Hot fomentations of the abdomen, and friction are very useful.

In FLATULENT COLIC, Dr Williams says, that no remedies are superior to ammonia, turpentine, and linseed oil. Puncture of the colon by a perforated needle is common in France, and if done early the relief is great and the prognosis favourable. Gunn's cannula, made by Arnold and Sons, is the form of instrument best suited for the performance of this operation.

COLLINSONIA CANADENSIS. *Syn.* STONE ROOT, KNOB ROOT. Much esteemed in America as a remedy for gravel and other urinary affections. Also valuable as a sedative and antispasmodic in flatulent colic and infantile and biliary colic. Tincture, 1 in 10 of proof spirit.—*Dose,* ½ to 1 dr. Liquid extract, 1 in 1.—*Dose,* 10 to 30 minims.

COLLODION. *Syn.* COLLO'DIUM, L., B. P. A viscid fluid formed by dissolving pyroxylin (Schönbein's gun-cotton) in a mixture of ether and alcohol. In *surgery,* it is used in its natural state, and combined with certain elastic and medicinal substances. In *photography,* it is used in combination with agents that render it sensitive to the action of light.

Collodion. *Syn.* PLAIN COLLODION. The fol-

lowing are the best methods of preparing plain collodion for surgical purposes:

Prep. 1. (Ph. U. S.) Take of pyroxylin, 4 parts; strong ether, 70 parts; alcohol, 26 parts. Add the pyroxylin to the alcohol and let it stand for 15 minutes; then add the ether, and shake till dissolved.

2. (*Mialhe.*) Nitrate of potassa, 40 parts; concentrated sulphuric acid, 60 parts; carded cotton, 2 parts; proceed as in No. 5 until the dry cotton is obtained, then take of the prepared cotton, 8 parts; rectified sulphuric ether, 125 parts; mix in a well-stoppered bottle, and agitate it for some minutes; then add gradually, rectified alcohol, 1 part; and continue to shake until the whole of the liquid acquires a syrupy consistency. It may be now passed through a cloth; but a better way to prevent loss is to let it repose for a few days, and then decant the clear portion.

3. (*Lauras.*) This process only differs from No. 2 in the following particulars:—The cotton is immersed for 12 minutes, then rinsed 2 or 3 times in cold water, and afterwards immersed in a solution of carbonate of potassa, 4 parts, and water, 200 parts. Lastly, it is plunged again into simple water, and dried at a temperature of 77°—86° F.

4. (B. P.) Pyroxylin, 1 part; rectified spirit, 12 parts; ether, 36 parts; mix the ether and spirit, and add the pyroxylin. Keep in a well-corked bottle.

5. (*Parrish.*) Thoroughly saturate clean carded cotton, ½ oz., with fuming nitric acid and sulphuric acid, of each, 4 fl. oz., previously mixed and allowed to become cool; macerate for 12 hours; wash the cotton in a large quantity of water; then free it from the water by successive washings in alcohol, and dissolve in ether, 3 pints.

Obs. For success in the manufacture of collodion it is absolutely necessary to avoid the presence of water. The ordinary commercial oil of vitriol, sp. gr. 1·84, may be used. Professor Procter, of Philadelphia, gives preference to the process with the mixed acids (No. 5), and directs that the cotton should be allowed to macerate for four days. In drying the cotton great care should be taken to prevent an explosion.

Uses, &c. In *surgery*, plain collodion is employed as a dressing for wounds, and as a protection to abraded surfaces. On drying, it unites the former closely and preserves the latter from the action of the air. It is impervious to water, and, being transparent, it admits of the progress of the wound being inspected when necessary. Such is its adhesive power, that a piece of cloth cemented with it to the dry palm of the hand will support a weight of 25 to 30 lbs. The parts to which it is applied should be freed from moisture. See COLLODIONS, COLOURED, ELASTIC, MEDICATED, and VESICATING (*below*).

Collodion, Blis'tering. See VESICATING COLLODION.

Collodion, Carbolic. Morphine acetatis, 1 gr.; olei menthæ pip., 4 minims; acidi carbolici, 20 gr.; collodii, ad 1 oz.; used on wool for toothache.

Collodion, Col'oured. *Syn.* COLLODIUM TINCTUM, L. *Prep.* (Cutan. Hosp.) Collodion, 2 oz.; palm oil, 1 dr.; alkanet root, q. s. to colour (say 15 gr.); digest and decant the clear. Colour bears a greater resemblance to the skin than that of common collodion, whilst it is more flexible; but it is weaker than the latter.

Collodion, Elas'tic. *Prep.* 1. (*Lauras.*) Heat together Venice turpentine, 2 parts; castor oil, 2 parts; and white wax, 2 parts; add sulphuric ether, 6 parts; and mix all with the product of No. 3 (*above*), that is, to the collodion formed with 8 parts of prepared cotton, 125 ether, and 8 alcohol.

2. (*C. S. Rand.*) Dissolve prepared cotton (No. 5, *above*), 2 dr., in sulphuric ether, 5 fl. oz.; then add, Venice turpentine, 2 dr., and complete the solution by slight agitation.

Obs. The collodion made by either of the above processes, when applied to the skin, forms a transparent pellicle, more pliable and more difficult to remove than that of ordinary collodion.

Collodion, Flexible. COLLODION FLEXILE. (B. P.). Mix collodion (B. P.), 6 fl. oz., with Canada balsam, 120 gr.; and castor oil, 1 fl. dr., and keep in a well-corked bottle.

Collodion, Hemostatic. Collodion, 10 parts; carbolic acid, 1 part; tannic acid, ½ part; benzoic acid, ½ part; all by weight. To be applied with a pencil brush.

Collodion, Iodised. This may be made at one operation; it should be kept two days before being used, but is less reliable if kept for any length of time than the sensitised collodion described below. It is made as follows:—Place 16 gr. of gun-cotton in a bottle, add 18 gr. of iodide of cadmium in powder, 6 gr. of bromide of cadmium in powder, and 1½ oz. of spirits of wine (sp. gr. 0·805). Shake the bottle until the iodide and bromide are dissolved, then add 3 oz. of ether, sp. gr. 0·720, and shake until the cotton is dissolved. After settling for 24 hours, decant the clear portion into small well-stoppered bottles.

Collodion, Med'icated. It has been proposed to medicate collodion in several ways, but the practice has not found much favour with the medical profession. The following preparations have been described:

COLLODION, ACONITE. From aconite root, by a similar formula to that of BELLADONNA C. (*below*).

COLLODION, BELLADONNA. *Prep.* Macerate select belladonna leaves, powdered, 8 oz., in ether, 12 fl. oz., with alcohol (95%), 4 fl. oz., for 6 hours. Pack in a percolator, and pour on alcohol till a pint of tincture is obtained; in this dissolve pyroxylin (gun-cotton), 1 dr., and Canada balsam, ½ oz. Used as a substitute for BELLADONNA PLASTER.

COLLODION, CANTHARIDIN. See COLLODION, VESICATING.

COLLODION, IODINE. *Prep.* Dissolve iodine and Canada balsam, of each, ½ oz., in collodion, 1 pint. Used as a substitute for IODINE OINTMENT.

Collodion, Morphia. (*L'Union Medicale.*) Dissolve 1 part of hydrochlorate of morphia in 30 parts of flexible collodion, and apply with a camel-hair brush.

Collodion, Photograph'ic. 1. There are so many methods adopted for preparing photographic collodion that a large volume might be filled with notices of them. We have retained Mr

Hardwich's forms, which were formerly much esteemed by practical photographers, and appended to them modern formulæ which are now, we believe, in much greater demand, and for which we are indebted to Mr Ernest Spon's valuable book 'Workshop Receipts.'

2. Pyroxylin and iodide of cadmium, or ammonium, of each, 15 gr.; ether, $3\frac{1}{2}$ oz.; alcohol, $1\frac{1}{2}$ oz. Place the two first in a dry bottle, then pour on the spirits of wine, shake the mixture well, then add the ether, shake again and let it stand for 12 hours. Decant the clear portion into a wide-mouthed bottle, keep well stoppered, and in the dark. Avoid shaking the bottle when about to use the collodion, and never quite use all the bottle contains, as the sediment which will accumulate at the bottom would spoil the picture. The preparation of a sensitive collodion, whether positive or negative, includes three distinct operations, namely, the formation of the pyroxylin, or gun-cotton, the conversion of this into plain collodion, and the final process of iodising the collodion.

Collodion, Plain. Mix in a bottle gun-cotton, 450 gr.; ether, 25 oz.; spirits of wine, 7 oz. Shake these well together, and leave to settle several days. Keep well corked.

Collodion, Pos'itive. (*Hardwich.*) To form the PYROXYLIN:—Take sulphuric acid, sp. gr. 1·845, at 60° F., 12 fl. oz.; nitric acid, sp. gr. 1·45, at 60° F., 12 fl. oz.; water, $3\frac{1}{2}$ fl. oz.; mix, and allow the temperature to fall to 140° F.; then immerse cotton, 300 gr. (If the cotton is found to gelatinise or dissolve in the acid mixture, the quantity of water is too great, and may be reduced to 3 fl. oz.) The cotton should be well pulled out in pieces, weighing about 30 gr. each; and should be left in the acid for about 8 minutes, the vessel being covered over. It is taken out with a glass spatula, squeezed to remove acid, washed for at least 24 hours by a stream of water, then squeezed in a cloth, and pulled out to dry. To form the PLAIN COLLODION:—Shake up the dry pyroxylin, 48 gr., with alcohol, sp. gr. ·805, $1\frac{1}{2}$ fl. oz., and then add ether, sp. gr. ·725, $4\frac{1}{2}$ fl. oz. The solution should be allowed to rest for a week or ten days, when the clear fluid should be decanted from the sediment. To prepare the IODISING SOLUTION:—Take of iodide of ammonium, $1\frac{1}{2}$ dr.; iodide of cadmium, $1\frac{1}{2}$ dr.; bromide of ammonium, 40 gr.; powder, and dissolve in alcohol, sp. gr. ·805 to ·816, 10 fl. oz. The collodion is iodised by adding the solution to it in the proportion of 1 part solution to 3 parts collodion. The iodised collodion should be kept for at least six weeks before using. If required for immediate use, add a few drops of an alcoholic solution of iodine, formed by dissolving 5 gr. of iodine in 1 fl. oz. of alcohol.

Obs. Mr Hardwich recommends that the cotton, before being converted into pyroxylin, should be cleansed by boiling for 2 hours in a solution of caustic potassa (2 oz. to the gall.), and by being afterwards repeatedly washed and dried. The purest nitric acid, sp. gr. 1·45, should be employed, but the ordinary commercial sulphuric acid (oil of vitriol) is sufficiently pure for use. To purify the ETHER and to get rid of a certain ozonised principle which would decompose the iodising solution, Mr Hardwich recommends the following process:—Take the best washed ether of commerce and agitate it thoroughly with a small portion of dilute sulphuric acid, and then introduce it into a retort, and distil over one third. The alcohol used is of the strength of that sold for absolute alcohol; it should be pure.

Collodion, Neg'ative. (*Hardwich.*) To form the PYROXYLIN:—Take of sulphuric acid, sp. gr. 1·845, at 60° F., 18 fl. oz.; nitric acid, sp. gr. 1·475, at 60° F., 6 fl. oz.; water, $5\frac{1}{4}$ fl. oz.; cotton, 300 gr. Mix, and allow the temperature to fall to 150° F. The weight of the pyroxylin ought to be 375 gr. To form the PLAIN COLLODION:—Take alcohol, sp. gr. ·806, $\frac{1}{2}$ gall.; ether, sp. gr. ·725, 1 gall.; pyroxylin, 1900 gr. Saturate the pyroxylin with the alcohol, then pour in half a gall. of the ether, agitate for 3 or 4 minutes, and repeat the process in adding the remainder. Decant the clear liquid from the sediment after a week or 10 days' rest. The following forms for IODISING SOLUTIONS are recommended:—*a.* (Potassium Iodiser.) Iodide of potassium, 135 gr.; alcohol, sp. gr. ·816, 10 fl. oz. Powder and dissolve in the alcohol, previously heated to 140° F. *b.* (Cadmium Iodiser.) Iodide of cadmium, 170 gr.; alcohol, sp. gr. ·816, 10 fl. oz. Dissolve in the cold, and filter. *c.* (Bromo-iodiser.) Bromide of ammonium, 40 gr.; iodide of ammonium, 90 gr.; iodide of cadmium, 90 gr.; alcohol, sp. gr. ·816, 10 fl. oz. Pulverise and dissolve in the cold. To sensitise the collodion, add to 3 parts 1 part of either *a*, *b*, or *c*.

Obs. Most of the practical directions given under the head of POSITIVE COLLODION apply equally to NEGATIVE COLLODION. Nothing but patient and intelligent practice will ever lead to success in preparing collodion for photographic purposes. Although formulæ of undoubted excellence may be used, it continually happens that the results are entirely nugatory from some trifling cause. See PHOTOGRAPHY.

Collodion, Sensitised. Add to 1 oz. of the plain collodion 6 dr. of spirits of wine; $1\frac{3}{4}$ oz. of ether; and 3 dr. of iodide and bromide solution (see *below*). Shake the bottle well; the mixture is then ready, but is improved by being kept 4 or 5 hours before using. In hot weather a little more alcohol and less ether; in very cold weather more ether and less alcohol must be used. As sensitised collodion does not keep well, it is better not to mix the plain collodion and the iodide and bromide solution until shortly before required for use.

Iodide and Bromide Solution. Iodide of cadmium, 154 gr.; bromide of cadmium, 54 gr.; spirits of wine, $3\frac{1}{2}$ oz. Pound the iodide and bromide very fine in a mortar, adding the spirit gradually; when the iodide and bromide are dissolved, pass the solution through a filter-paper into a bottle. Must be kept in a closely stoppered bottle.

Collodion, Styptic. *Syn.* STYPTIC COLLOID. (*Dr Richardson.*) To a saturated solution of tannic acid in alcohol and ether, in equal parts, add as much pyroxylin as the liquid will dissolve.

Collodion Vesicans. BLISTERING COLLODION (B. P.) Place 5 oz. of powdered Spanish-fly in a percolator and pass slowly through it acetic ether until a pint is collected. To this add 1 oz. of pyroxylin, and shake till dissolved.

Collodion, Ves'icating. *Syn.* Blis'tering collodion, Canthar'idin c.; Collo'dion ves'icans, L. *Prep.* 1. (*Tichborne.*) Coarsely powdered cantharides, 6 oz., are placed loosely in a displacement apparatus (provided with a tap to regulate the flow), and treated with ether from methylated spirit, 13 fl. oz., and glacial acetic acid, 2 fl. oz., previously mixed together. After the fluid has passed through it will be found that the *débris* has retained by absorption 7 fl. oz., which must be displaced by the gradual addition of methylated spirits of wine, 7 fl. oz. If properly managed, there is not the least danger of the admixture of the spirits with the percolated menstruum, as the animal substance of the flies swells considerably under the prolonged influence of the spirits of wine, so that the same bulk will be insufficient to quite displace the ether. The ethereal solution should be made to measure exactly 15 fl. oz. with a little spirit, and may then be converted into a collodion by the addition of pyroxylin, ½ oz.

Obs. The glacial acid plays a double part in this preparation. It dissolves the cantharidin, and at the same time gives to the collodion film the essential property of porosity. Ordinary collodion is useless as an excipient, for it produces a tough and contractile film, which really screens the skin from the action of the greater part of the blistering material.

2. (*Ilisch.*) Cantharidin, 15 gr.; pyroxylin, 20 gr.; rectified ether, 1½ oz.; acetic ether, ½ oz.; dissolve.

3. (*Œttinger.*) Ether of cantharides and collodion, equal parts.

Use. Vesicating collodion is used as an irritant. No. 1 was introduced in 1862, and has many advantages over the other two. Mr Tichborne thus describes the most effectual method of using it in the 'Pharm. Journ.':—"The part upon which the blister is to be raised should be painted with the vesicant to the desired extent, bearing in mind that the blister produced always extends to about 1-10th of an inch beyond the margin of the space covered. Care should be taken to give a coating of considerable thickness, and to ensure this result the brush should be passed over and over again, until about ½ dr. has been used to the square inch, or less, when operating upon a tender epidermis. It is desirable to place over the intended blister a piece of oiled silk, or, what is still better, a piece of sheet gutta percha, somewhat larger than the surface painted, as this will stop the exhalations of the skin, and so render it moist and permeable. In 10 minutes, or a quarter of an hour, if the cuticle is hard, the collodion should be wiped off with a little cotton-wool moistened with ether, when the blister will almost instantly rise."

COL'LOID. See Dialysis.

COLLYR'IUM. [L.] In *medicine* and *pharmacy*, a topical remedy for diseases of the eye. Formerly the term collyrium was applied to any medicament employed to restrain defluxions.

Collyrium, Liq'uid. See Waters (Eye).

Collyrium, Unct'uous. See Ointments (Eye).

COL'OCYNTH (sĭnth). *Syn.* Colocynth pulp., Colocynthidis pulpa, B. P. Bit'ter ap'ple, Bitter gourd, Bitter cu'cumber, Peeled colocynth; Coloquint'ida, Colocynth'is (B. P.), L. The decorticated fruit or pulp of the *Citrellus colocynthis,* Schrad. (Ph. L.), or *Cucumis colocynthis,* Linn. (Ph. E. and D.). It is an acrid, drastic purge and hydragogue, and cannot be given alone with safety; but, in combination with other substances, it forms some of our most useful cathartic medicines.

COLOCYNTH'IN. *Syn.* Colocynth'ium, L. The bitter, purgative principle of colocynth.

COL'OPHENE. Formed by distilling oil of turpentine with concentrated sulphuric acid. A colourless, viscid, oily liquid; with a high boiling-point; and exhibiting a bluish tint by reflected light.

COL'OPHONY. See Resin.

COLORADO BEETLE. *Syn.* Doryphera decemlineata. The Colorado potato-beetle belongs to the family *Chrysomelidæ,* and is a native of the eastern slopes of the Rocky Mountains. It measures nearly ½ inch in length, and has a tawny or yellowish cream-coloured body, darkly spotted, with wing cases which are marked with 10 black longitudinal stripes. It has been gradually migrating eastward towards the cultivated lands of the Northern States, until it has reached the Atlantic coast. It is now found over all the central and northern parts of the United States east of the Rocky Mountains, as well as throughout Canada, on the potato-crops of all of which regions it has committed incalculable ravages. The leaves and stalks are the parts of the potato-plant principally attacked, the depredators being, for the most part, the larvæ, of which three broods are said to be produced annually.

In America, we believe, the only means of destroying these insects, as well as their eggs and larvæ, consists in the application to the plant of the highly poisonous and dangerous pigment, Scheele's green, a hydrated arsenite of copper. M. Girard recommends in preference to the arsenical salt a liberal use of sulpho-carbonate of potash. This insect is especially dealt with by 40 and 41 Vict., cap. 68, which forbids under penalty the landing of material in Great Britain, likely to contain the beetle, or its ova, or grubs. The destruction of infected crops, and the compensation of the owners is also provided for. The Local Authorities under the Contagious Diseases (Animals) Act, 1869, are the Local Authorities for purposes of this Act.

The scare caused by the appearance of the Colorado beetle in England in 1876–77 has proved not to have been justified, as the beetle apparently cannot thrive in our island.

COLOUR BLINDNESS. *Syn.* Daltonism. A curious defect of vision, from which the eye is incapable of distinguishing colours. It is of three kinds:—1. An inability to distinguish any colour properly so called, the person being only able to distinguish white and black, light and shade. 2. An inability to distinguish between the primary colours, red, blue, and yellow, or between these and the secondary or tertiary hues, such as green, purple, orange, and brown. 3. An inability to distinguish nicer shades and hues, as greys and neutral tints. The first form is rare; the second and third are common. Dr

George Wilson found that of 1154 persons examined by him in Edinburgh, 65, or 1 in 177, were colour blind; of these, 21 confounded red with green, 19 brown with green, and 25 blue with green.

The colour vision of more then 5% of the population appears to be defective to a serious extent, and the necessity for testing the capacities of railway employés, and others, in this respect is now fully recognised. There is a large amount of defective colour vision which is merely due to want of education and the cultivation of the habit of distinguishing shades and tints, but true colour blindness is an organic and incurable defect. Sets of coloured wools, named and numbered, can now be procured almost anywhere; these are mixed, and given to the person to be tested to sort and arrange. Children should have every opportunity given them of training their colour sense, it is as cultivable as any other of our senses, and is often of the greatest practical value.

COL'OURING. *Syn.* BRANDY COLOURING, BREWER'S C., SPIRIT C., CAR'AMEL; ESSEN'TIA BI'NA, L. *Prep.* Brown sugar is melted in an iron vessel over the fire until it grows black and bitter, stirring it well all the time, after which water is added, and it is boiled to a syrup. In the making of brandy colouring white sugar is more frequently used.

Obs. Some persons use lime-water to dissolve the burnt sugar. Care must be taken not to overburn it, as a greater quantity is thereby rendered insoluble. The heat should not exceed 430° F., nor be less than about 400° F. The process, for nice experiments, is best conducted in a bath of melted tin, to which a little bismuth has been added to reduce its melting-point to about 435° F.; a little powdered resin or charcoal or a little oil being put upon the surface of the metal to prevent the oxidation of the alloy. See CARAMEL.

COL'OURS. White light from the sun is of a compound nature, and may be decomposed into rays of different colours. Newton distinguished seven PRIMITIVE COLOURS, namely, violet, indigo, blue, green, yellow, orange, and red. Sir D. Brewster is disposed to think that four of these colours are really compound, and that three, namely, blue, yellow, and red, alone deserve the name of primitive. The colour of natural objects are supposed to result from the power possessed by their surfaces of absorbing some of the coloured rays of light, while they reflect or transmit, as the case may be, the remainder of the rays. Thus, an object appears red because it absorbs or causes to disappear the yellow and blue rays composing the white light by which it is illuminated. Black and white are not colours, strictly speaking.

A body is said to be black when it absorbs or quenches a large proportion of all the rays of white light falling upon it. A body is said to be white when it receives the white light, and reflects all the rays with moderate strength. Grey may be regarded as a luminous black or dark white. The names given to colours are far from being satisfactory, for although many thousand shades may be distinguished by a practised eye, it is a question whether there are fifty names which would convey the same idea of shade to any ten colourists in the world. The names taken from natural coloured objects, as indigo, violet, orange, lilac, amber, emerald, &c., are the least objectionable. M. Chevreul has devised an ingenious system of naming and classifying colours. He employs only 6 fundamental names, which are those of the 3 elementary colours, red, yellow, and blue; and of the 3 secondary colours, orange, green, and violet. By the direct union of the elementary and secondary colours, 6 tertiary colours are formed. He arranges the 12 colours in a circle, like the spokes of a wheel, commencing with the red, and going to the right, thus:—Red, red-orange, orange, yellow-orange, yellow, yellow-green, green, blue-green, blue, blue-violet, violet, red-violet. The chromatic circle is completed by placing 5 shades between the red and red-orange, 5 between the red-orange and orange; and so on between each of the other couples. This chromatic circle of 72 colours is not imaginary, but actually exists, composed of dyed wools. The shades are distinguished by numbers; thus, there are red, 1 red, 2 red, 3 red, 4 red, and 5 red, &c. Each of the 72 shades has, moreover, 20 different degrees of depth, from the lightest that can be discerned, from pure white to the most intense depth, approaching to brown and black. These degrees of depth are called tones or tints. The addition of these tones to the chromatic circle brings up the number of tints to 1440. To indicate any one of these tints we have merely to write the number of the shade, and after it the number of the tone, as, for example, 3 blue-violet, 13 tone. By mixing each of the 1440 tints with grey or black, so as to darken it in different degrees, a total of 14,440 colours may be defined. This part of the system is generally regarded as unnecessary. Mr O'Neill, in his valuable 'Dictionary of Calico Printing and Dyeing' (to which work we refer the reader for a full account of Chevreul's classification), gives a long list of colours and coloured bodies which are pretty well defined in common language, with the names of the colours according to this ingenious system. We select from this list the following examples:

Amber in mass = 2 orange, 12 tone.
Amethyst = 5 blue-violet, from 3 to 16 tone.
Blood, ox = 1 red, 13 and 14 tones.
Butter = yellow-orange, 2 to 3 tone.
Carrot = orange, 7 tone.
Chocolate in cake = 5 orange, 18 tone.
Emerald = 2 green, 11 tone.
Green, apple = 4 yellow-green, 8 tone.
Isabelle = 1 yellow-orange.
Mauve = 3 violet, 8 tone.
Red-lead = yellow-orange, 20 tone.
Ruby = red, 11 tone.
Yellow, canary = 1 yellow, 6 tone.

For notices of DYES, PIGMENTS, &c., refer to the principal colours.

Colours, Cake. *Syn.* ARTISTS' COLOURS. These are made by grinding by means of a glass muller and a slab, the respective pigments, previously reduced to powder, into a smooth paste with equal parts of isinglass size and thin gum-water. The paste is then compressed into squares as tightly as possible, and dried with a very gentle heat. Old crumbling cake colours should be powdered very finely in a biscuit-ware mortar, sifted through

fine muslin, and ground up as above, the gum-water being omitted. The powders rubbed up with honey to the consistence of cream constitute moist colours.

Colours, Complement'ary. *Syn.* Accident'al Colours. Colours are said to be complementary to each other which, by blending together, produce the perception of whiteness. According to Mayer, all colours are produced by the admixture of red, yellow, and blue light, in certain proportions; and by intercepting either one or more of these coloured rays in a beam of light, those which meet the eye will consist of the remaining coloured rays of the spectrum. Thus, by intercepting the red rays in a beam of white light, the remaining yellow and blue rays will produce a green colour; by intercepting the blue rays, the remaining yellow and red will give an orange; and so on of other cases; so that red and green, blue and orange, are complementary colours. If we look for some time, with one eye, on a bright-coloured object, as a wafer, placed on a piece of paper, and subsequently turn the same eye to another part of the paper, a similarly shaped spot or mark will be seen, but the colour will vary, though it will be always the same under like circumstances. Thus, if the original spot or wafer be of a red colour, the imaginary one will be green; if black, it will be white; the imaginary colour being always complementary of that first gazed upon. The colour so perceived is often called an accidental colour, to distinguish it from the real colour. It is a general maxim in design that "colours look brightest when near their complementary colours."

Colours, Druggists' Show. See Show Bottles.

Colours, Flame. See Fires (Coloured).

COLTS'FOOT. This popular herb is the *Tussilago farfara* of Linnæus. It is a demulcent bitter, and is slightly stomachic and tonic. It is much esteemed by the lower classes in coughs, shortness of breath, and other affections of the chest. The leaves form the basis of most of the British herb tobaccos, and have been recommended to be smoked in asthma and difficulty of breathing. —*Dose.* One or two wine-glassfuls of the tea or decoction (1 oz. to the pint) *ad libitum.*

COLUM'BIC ACID. See Tantalic Acid.

COLUM'BIUM. See Tantalum.

COMA. A deep heavy sleep, from which the patient cannot be aroused. See Apoplexy.

COMACHROME FOR DYEING THE HAIR BLACK. Nitrate of silver solution, with pyrogallic acid (*Reveil*).

COMBINATION. In *chemistry,* the union of dissimilar substances to form a new substance termed a *chemical compound,* which is possessed of certain definite properties, and whose formation takes place in accordance with the following laws of chemical combination, first enunciated by Dalton at the beginning of this century.

1. The proportions in which substances unite together chemically are definite and constant. In other words, a given chemical compound always consists of the same elements united in the same proportion, and the weight of the compound is equal to the sum of the weights of its constituents. For example, 16 parts by weight of oxygen invariably unite with 2 parts of hydrogen to form 18 ($=16+2$) parts of water.

2. When two elements combine in more than one proportion, the quantities of one element which combine with the same quantity of the other stand in a simple ratio to each other. For example, 16 parts by weight of oxygen unite with 12 parts by weight of carbon to form carbonic oxide, while 32, *i. e.* 16×2, parts of oxygen unite with 12 parts of carbon to form carbonic anhydride.

3. The weights of two different elements, A and B, which combine with the same weight of a third, C, represent the proportions in which they combine with each other, or bear some simple relation to these proportions. For example, 35·5 parts of chlorine, or 127 parts of iodine, combine with 39 parts of potassium, forming respectively potassium chloride or iodide; while 35·5 parts of chlorine combine with 127 parts of iodine to form iodine chloride. Also 2 parts of hydrogen, or 16 parts of sulphur, combine with 16 parts of oxygen to form respectively water or sulphurous acid respectively, while 2 parts of hydrogen combine with 32, *i. e.* 16×2, parts of sulphur to form sulphuretted hydrogen.

The following law of combination by volume was discovered, about the same time as the above, by Gay Lussac:—When gases combine together they do so in equal volumes, or in volumes which have some simple relation to each other. (The volumes of the gases are measured under the same conditions of temperature and pressure.)

For example, 1 volume of hydrogen combines with 1 volume of chlorine, or 2 volumes of hydrogen with 1 of oxygen, or 3 of hydrogen with 1 of nitrogen, or 4 of hydrogen with 1 of carbon, the resulting compound, which is hydrochloric acid gas, steam, ammonia, or marsh-gas respectively, when measured in the gaseous state under the same conditions of temperature and pressure, in each case occupies 2 volumes.

COMPOUND CHINESE TABLET OF ALABASTER. (*John Irvine.*) A cosmetic powder for the skin. It consists of chalk, free from injurious metals (*Chandler*).

Compound Chinese Tablet of Alabaster. (*Shand.*) Identical in use and composition with the last-mentioned powder.

COMPOUND SUGAR-COATED MAY-APPLE PILLS. (*Dr Scott.*) Recommended as 'anti-bilious, cathartic, chemical family pills.' Sugar-coated pills, consisting of bitter extract, powdered podophyllum root, rhubarb, jalap, and pepper (*Hager*).

COMPRESSES DESINFECTANTES DE LE PERDRIEL. Charcoal powder incorporated with paper.

CONCENTRA'TION. The volatilisation of part of a liquid in order to increase the strength of the remainder. The operation can only be performed on solutions of substances of greater fixity than the menstrua in which they are dissolved. Many of the liquid acids, solutions of the alkalies, &c., are concentrated by distilling off their water.

In *pharmacy,* the term concentrated is commonly applied to any liquid preparation possessing more than the usual strength. Thus, we have

concentrated infusions, decoctions, liquors, solutions, tinctures, and essences, most of which are made of 8 times the common strength. This is generally effected by using 8 times the usual quantity of the ingredients, with a given portion of the menstruum, and operating by digestion and percolation; the latter being generally adopted when the articles are bulky. When the menstruum is water, a little spirit is added, to make the product keep. See DECOCTION, INFUSION, &c.

CON'CRETE. A compact mass of cement, composed of pebbles, lime, and sand, employed in the foundations of buildings. The best proportions have been said to be—60 parts of coarse pebbles, 25 of rough sand, and 15 of lime; but Semple recommends 80 parts of pebbles, 40 parts of river sand, and only 10 parts of lime. The pebbles for concrete should not exceed about ½ lb. each in weight.

CON'DIMENTS. Substances taken with the food to season or improve its flavour, or to render it more wholesome or digestible. The principal condiments are COMMON SALT, VINEGAR, LEMON-JUICE, SPICES, AROMATIC HERBS, OIL, BUTTER, SUGAR, HONEY, and SAUCES. Most of these, in moderation, promote the appetite and digestion, but their excessive use tends to vitiate the gastric juice, and injure the stomach.

CONDURANGO. The bark of *Gonolobus condurango.* Used as an alterative in chronic syphilis, and supposed to be a specific for cancer. In a case of cancer of the stomach it mitigated the pain, improved the appetite, and increased the weight of the patient. A tincture, 1 in 10 of proof spirit, is used.—*Dose,* 1 to 4 dr.

CONDY'S FLUID (from England). A weak solution of permanganate of soda (*Wittstein*).

CONESSI (*Holarrhena antidysenterica,* Wall.). A small Indian tree whose wood is largely used for carving, turnery, furniture, &c., and the bark and seeds in Hindoo medicine, the former is one of their principal remedies for dysentery; both are very bitter.

CONFEC'TION. *Syn.* CONFECTIO, L. Anything prepared with sugar; a sweetmeat or candy. In *medicine,* the name is commonly applied to substances, usully pulverulent, mixed up to the consistence of a soft electuary with powdered sugar, syrup, or honey. In the London Pharmacopœia (1836 and 1851) both CONSERVES and ELECTUARIES are included under this head, though there appears to be some little distinction between them.

In the preparation of confections, all the dry ingredients should be reduced to very fine powder, and passed through a sieve, not coarser than 80 holes to the inch; and the pulps and syrups used to mix them up should be perfectly homogeneous and of a proper consistence. The mixture should be intimate and complete, in order that the characteristic constituents may be equally distributed throughout the mass. The consistence of the newly made confection should be sufficiently solid to prevent a separation of the ingredients, and yet soft enough to allow of it being easily swallowed without previous mastication.

Confections should be preserved in stone jars covered in writing paper, and placed in a cool and not too dry situation. Without this precaution they are apt to mould on the top. If at any time the mass ferments and swells up, the fermentative process may be arrested by placing the jar in a bath of boiling water for an hour or two, or until the whole becomes pretty hot; when it should be removed from the heat, and stirred occasionally until cold. Should the sugar crystallise out of the confection, or 'candy,' as it is called, the same method may be followed. Or, the mass may be well rubbed in a mortar until the hard lumps of sugar are broken down and a uniform consistence again produced. On the large scale it may be passed through the mill.

Confection of Almonds. *Syn.* ALMOND PASTE, CONSERVE OF ALMONDS; CONFEC'TIO AMYG'DALÆ (Ph. L.), CONSER'VA AMYGDALA"RUM (Ph. E.), CONFEC'TIO AMYGDALA"RUM (Ph. D. 1826), L. *Prep.* (Ph. L.). Sweet almonds, 8 oz.; white sugar, 4 oz.; powdered gum-arabic, 1 oz.; macerate the almonds in cold water, then remove the skins and beat them with the other ingredients until reduced to a smooth confection. The Ph. E. formula is similar. See POWDERS, COMPOUND POWDER OF ALMOND.

Uses, &c. To prepare EMULSION of MILK OF ALMONDS. A little of this paste or powder, triturated with a sufficient portion of water and strained through a piece of calico, forms emulsion of almonds. "This confection will keep longer sound if the almonds, first decorticated (blanched), dried, and rubbed into the finest powder be mixed with gum, acacia, and sugar, separately powdered, and the mixed ingredients be kept in a well-stoppered bottle" (Ph. L.). The same effect may be arrived at by simply well drying the blanched almonds before mixing them with the gum and sugar. The addition of even a small quantity of water or syrup causes the confection "to become soon mouldy, or rancid, or both" (*Brande*).

Confection of Al'um. *Syn.* CONFECTIO ALU'MINIS, L. *Prep.* 1. (St B. H.) Alum (in fine powder), 2 dr.; treacle, to 1 oz.

2. (*Foy.*) Alum, 1 dr.; conserve of roses, 1 oz.—*Dose,* 1 dr., 2 or 3 times a day; in lead colic, and as an astringent in diarrhœa and other affections.

Confection, Aromatic. *Syn.* AROMATIC ELEC'TUARY; CONFEC'TIO AROMATI'CA (Ph. L. & D.), ELECTUA"RIUM AROMAT'ICUM (Ph. E.), L. *Prep.* 1. (Ph. L.) Nutmegs, cinnamon, and hay-saffron, of each, 2 oz.; cloves, 1 oz.; cardamoms, ½ oz.; prepared chalk, 16 oz.; white sugar, 2 lbs.; reduce the whole to a fine powder, and keep it in a closed vessel. When wanted for use, mix it with water to the consistence of a confection.

2. (Ph. E.) Aromatic powder (Ph. E.), 1 part; syrup of orange peel, 2 parts; mix.

3. (Ph. D.) Aromatic powder and simple syrup, of each, 5 oz.; clarified honey, 2 oz.; powdered saffron, ½ oz.; mix, and add oil of cloves, 30 drops.

4. (Commercial.) *a.* Hay-saffron, cassia and turmeric, of each, 4 oz.; cardamoms, 1 oz.; starch, 8 oz.; precipitated chalk, 2 lbs.; white sugar, 4 lbs.; oil of nutmeg, 2 dr.; oil of cloves, 3 dr.; reduce the dry ingredients to fine powder, and

pass it through a sieve (80 holes); then add the oils, and after well mixing them in, pass the whole through a coarse sieve (about 40 holes to the inch), to ensure perfect admixture.

b. Hay-saffron, 4 oz.; turmeric, 3 oz.; powdered starch, 8 oz.; precipitated chalk, 2 lbs.; white sugar, 4 lbs.; oil of cloves and cassia, of each, 3 dr.; oil of nutmeg, 2 dr.; essence of cardamoms, 1 oz.; boil the saffron turmeric in 1 gall. of water, placed in a bright copper pan for 10 minutes, then, without straining, add the chalk, starch, and sugar; mix well, and continue stirring until the mixture becomes quite stiff, then break it up, dry it thoroughly by the heat of a steam or water-bath; next reduce it to fine powder, which must be passed through a fine sieve, as before; the oils and tincture are now to be added, and, after being well mixed and passed through a coarse sieve, it should be placed in a jar or bottle and bunged up close. Very bright coloured.

Obs. In the wholesale trade this article is kept under two forms—one, in powder, as ordered by the College, and commonly called for distinction's sake PULV'IS CONFECTIO'NIS AROMAT'ICÆ: the other, mixed up ready for use. In preparing the latter, it is a common plan to make a strong infusion or decoction of the saffron, and to use it to mix up the other ingredients, adding the aromatics last. (See 4, *b.*). When the price of precipitated chalk is an objection to its use, prepared chalk may be used instead. There is much anxiety evinced by the wholesale druggists to prepare this confection of a rich colour, without an undue expenditure of saffron, which is generally economised on account of its costliness. This confection is cordial, stimulant, antacid, and carminative.—*Dose,* 10 to 60 gr., either as a bolus or stirred up with a glass of water; in diarrhœa, acidity of stomach, heartburn, and any like affection if accompanied by looseness of the bowels. In diarrhœa, English cholera, and flatulent colic, ¼ gr. of powdered opium may be added to each dose. See POWDERS, POWDER OF CHALK, COMPOUND.

Confection of Bark. *Syn.* CONFEC'TIO CINCHO'NÆ, L. *Prep.* 1. Yellow bark and white sugar, of each, 1 oz.; capsicum, 1 dr.; simple syrup, 4 oz.

2. (St B. Hosp.) Yellow bark, 6 dr.; ginger, ½ dr.; treacle, 3½ oz.—*Dose,* 1 to 6 dr., where the the use of bark is indicated.

Confection of Cas'sia. *Syn.* CONFEC'TIO CAS'SIÆ (Ph. L.), L. *Prep.* (Ph. L.) Prepared cassia, ½ lb.; manna, 2 oz.; prepared tamarinds, 1 oz.; syrup of roses, 8 fl. oz.; mix with heat, and evaporate to a proper consistence.—*Dose,* 2 dr. to 6 dr.; or more, as a laxative.

Confection of Cat'echu. *Syn.* CONFEC'TIO CAT'ECHU COMPOS'ITA (Ph. D.), L. *Prep.* (Ph. D.) Compound powder of catechu, 5 oz.; simple syrup, 5 fl. oz.—*Dose,* 10 gr. to 20 gr.; as an astringent, in diarrhœa, &c.; either alone or combined with chalk.

Confection of Copai'ba. *Syn.* CONFEC'TIO COPAI'BÆ, L. *Prep.* 1. (*Berton.*) Copaiba and powdered cubebs, of each, 2 oz.; alum, 1 oz.; opium, 5 gr.; mix well.

2. (*Swediaur.*) Turpentine, 1 oz.; copaiba, ½ oz.; mix; add mucilage of gum-arabic, 1 oz.; triturate to an emulsion, and further add conserve of roses, 4 oz.

3. (*Traill.*) Copaiba, 2 oz.; oatmeal, q. s. to form an electuary; then add conserve of roses, 1 oz.

4. (*Voght.*) Copaiba and powdered cubebs, of each, 4½ dr.; yelk of 1 egg; conserve of roses, ½ oz. All the above are excellent medicines in gonorrhœa.—*Dose,* 1 to 3 dr. 3 or 4 times a day, made into boluses, and covered with the fresh emptied skin of a raisin or wafer paper before being swallowed; in gonorrhœa, gleet, &c.

Confection of Cream of Tar'tar. *Syn.* CONFECTION OF BITAR'TRATE OF POTAS'SA; CONFEC'TIO POTAS'SÆ BITARTRA'TIS, L. *Prep.* 1. Cream of tartar and powdered sugar, of each, 1 oz.; simple syrup, 2 oz.; 1 nutmeg, grated.—*Dose,* 2 dr. to 6 dr.

2. (St B. Hosp.) Bitartrate of potassa, 4 dr.; treacle, 1 oz.; ginger, 5 gr.—*Dose,* 1½ dr. to 5 dr. Both are laxatives, well adapted for women and children.

Confection of Hem'lock. *Syn.* CONFEC'TIO CO'NII, L. *Prep.* (*Marshall Hall.*) Fresh hemlock leaves beaten up with an equal weight of sugar.—*Dose,* 10 to 20 gr. as a bolus, 2 or 3 times daily, where the use of hemlock is indicated. The confection of other narcotic plants may be made in the same way.

Confection of Hips. *Syn.* CON'SERVE OF HIPS, CONFECTION OF DOG-ROSE, CONSERVE OF D.-R.; CONFEC'TIO RO'SÆ CANI'NÆ (Ph. L.), CONSER'VA ROS'Æ FRUC'TÛS (Ph. E.), L. *Prep.* 1. (B. P.) Hips, 1 part; refined sugar, 2 parts; beat the hips in a stone mortar, rub the pulp through a sieve, add the sugar, and mix thoroughly. —*Dose,* 60 gr. or more.

2. (Ph. L.) Fruit of the dog-rose, without the seeds (carpels), 1 lb.; pound it to a pulp, add, gradually, powdered white sugar, 20 oz.; and beat them together until thoroughly incorporated.

3. (Ph. E.) Pulp of hips, 1 part; white sugar, 3 parts; as No. 1.

4. (Wholesale.) Pulped hips, 2 cwt.; fine white sugar, 3 cwt.; incorporate them without applying heat.

Obs. Both this and the confection of red roses have a brighter colour, if made without heat, or touching metallic vessels. On the small scale it is generally made by beating the ingredients together in a marble mortar, but in large quantities by grinding in a mill. Great care must be taken to remove the seeds (carpels) with the hair surrounding them, before pulping the fruit, as they are apt, like the hairs of cowhage, when swallowed, to produce vomiting, itching about the anus, &c. This conserve is slightly laxative, and is principally used for forming pills. It is very apt to candy by keeping.

Confection of Ipecacuan'ha. *Syn.* CONFEC'TIO IPECACUANHÆ, L. *Prep.* (*Bories.*) Ipecacuanha, 12 gr.; sulphur, 20 gr.; orris root, 1 dr.; syrup of mallows and manna, of each, 2 oz.—*Dose,* a teaspoonful, 2 or 3 times daily; in hooping-cough, dyspepsia, &c.

Confection of Jal'ap. *Syn.* CONFEC'TIO JAL'APÆ, C. J. COMPOS'ITA, L. *Prep.* (St B. Hosp.) Comp.

powder of jalap, 2 dr.; treacle to 1 oz.—*Dose*, 1 to 3 dr. as a purgative.

Confection of Kermes. (L. P. 1745.) Strained juice of kermes, 3 lbs.; rose water, 6 fl. oz.; white sugar, 1 lb.; oil of cinnamon, 10 gr.

Confection of Mer'cury. *Syn.* CONFEC'TIO HYDRAR''GYRI, C. MERCURIA'LIS, L. *Prep.* 1. Stronger mercurial ointment (Ph. L.), 1 part; conserve of roses, 3 parts.

2. (*Dr D. Davis.*) Mercury and manna, equal parts; treacle, q. s.; triturate until the globules of mercury disappear.

Dose, &c. The same as those of mercurial pill.

Confection of Ni'tre. *Syn.* CONFEC'TIO POTAS'SÆ NITRA'TIS, L. *Prep.* 1. Nitre, 1 part; confection of roses, 6 parts; oil of juniper, a few drops.

Confection of Opium. *Syn.* CONFEC'TIO O''PII (B. P.), ELECTUA''RIUM O''PII (Ph. E.), L. *Prep.* 1. (B. P.) Compound powder of opium, 192 gr.; syrup, 1 oz.

2. (Ph. L.) Powdered opium, 6 dr.; long pepper, 1 oz.; ginger, 2 oz.; caraways, 3 oz.; tragacanth, 2 dr.; reduce to fine powder, and keep it in a closed vessel; for use, add to it by degrees hot syrup, 16 fl. oz. (*i. e.* 3½ dr. of the powder to each fl. oz. of syrup.) It contains 1 gr. opium in every 36 gr.

3. (Ph. E.) Aromatic powder, 6 oz.; senega, 3 oz.; opium, diffused in a little sherry, ½ oz.; syrup of ginger, 1 lb. Contains 1 gr. of opium in every 43 gr.

Uses, &c. This confection is intended as a substitute for the once celebrated Mithridate, philonium, and theriaca of the old Pharmacopœias. It is stimulant, anodyne, and narcotic.—*Dose*, 5 to 30 gr.; in flatulent colic and diarrhœa unaccompanied by fever.

Confection of Or'ange Flowers. *Syn.* CONFEC'TIO FLOR'UM AURAN''TII, L. *Prep.* 1. Orange flowers, 1 part; white sugar, 2 parts; beat together to a confection.

2. (*Tadei.*) Orange flowers, 1 part; simple syrup, 3 parts; evaporate to a proper consistence. Both are used as agreeable adjuncts or vehicles for other medicines. The first is the best article.

Confection of Or'ange Peel. *Syn.* CONFECTION OF ORANGE, CONSERVE OF ORANGE PEEL; CONFEC'TIO AURAN''TII (Ph. L.), CONSERVA AURAN''TII (Ph. E.), CONSER'VA AURANTIO''RUM (Ph. L. 1824), L. *Prep.* (Ph. L. and E.) External rind of the fresh orange, separated by rasping, 1 lb.; beat it in a stone mortar with a wooden pestle to a pulp, then add white sugar, 3 lbs.; and beat them together until incorporated.

Uses, &c. This confection is an agreeable tonic and stomachic; it is much used as an adjunct to bitter and purgative powders, and as a vehicle for the sesquioxide of iron.

Confection of Pep'per. *Syn.* CONFECTION OF BLACK PEPPER, WARD'S PASTE; CONFEC'TIO PIP'ERIS (B. P.), C. P. NI'GRI (Ph. D. and Ph. L. 1836), ELECTUA''RIUM PIP'ERIS (Ph. E.), L. *Prep.* 1. (B. P.) Black pepper, in fine powder, 2 parts; caraway, in fine powder, 3 parts; clarified honey, 15 parts; triturate.—*Dose*, 60 to 120 grains.

2. (Ph. L.) Black pepper and elecampane, of each, 1 lb.; fennel, 3 lbs.; white sugar, 2 lbs.; reduce to a very fine powder, and keep it in a covered vessel; for use, add it, gradually, to honey, 2 lbs.; and beat the whole to a paste (*i. e.* 2 oz. of honey to each 7 oz. of powder).

3. (Ph. E.) As the last, but using liquorice powder instead of elecampane, and at once making a confection.

4. (Ph. D.) Black pepper and liquorice root, of each, ½ oz.; refined sugar, 1 oz.; oil of fennel, ½ fl. oz.; honey, 2 oz.; mix.—*Dose*, of each of the above, 1 to 3 dr. 2 or 3 times daily, for 3 or 4 months; in piles, fistula, &c., unaccompanied with inflammatory symptoms. Or it may be used as a suppository. It is intended as a substitute for the once celebrated nostrum, 'Ward's Paste for the Piles.'

Confection of Pep'permint. *Syn.* CONFECTIO MEN'THÆ PIPERI'TÆ, L. Green peppermint, 4 oz.; white sugar, 12 oz. Anti-emetic and antiflatulent; in colic, diarrhœa, &c; in the form of a bolus, or made into a mixture.

Confection of Re'sin. *Syn.* CONFECTIO RESIN'Æ, L. *Prep.* (*Dr Watson.*) Powdered resin, 1 oz.; balsam of copaiba, ½ oz.; honey, 5 oz.—*Dose*, 1 to 3 dr.; in piles and gleet. It is best combined with a little confection of orange peel, which effectually covers the taste of the copaiba.

Confection of Ro'ses. *Syn.* CONFECTION OF RED ROSES; CONFEC'TIO RO'SÆ (Ph. L. and D.), CONSER'VA RO'SÆ (Ph. E.), CONFEC'TIO R'OSÆ GAL'LICE (B. P.). CONSER'VA R. G. (Ph. L. 1824), L. *Prep.* 1. (B. P.) Fresh red-rose petals, 1 lb.; white sugar, 3 lbs.; mix as confection of hips.

2. (Ph. E.) Fresh petals, 1 part; sugar, 2 parts.

3. (Ph. D.) *a.* Fresh petals, 3 oz.; sugar, 8 oz. Or—

b. Dried petals, 1 oz.; water, 2 fl. oz.; macerate for 2 hours; then add refined sugar, 8 oz.; and beat to a mass as before.

Obs. It is astringent and tonic, but is principally used as an elegant vehicle for more active medicines. It keeps well, and does not candy like confection of hips.—*Dose*, 1 to 2 dr., either alone or combined with chalk; in slight cases of diarrhœa, vomiting in pregnancy, &c. See CONSERVE.

Confection of Rue. *Syn.* CONFECTIO RU'TÆ (Ph. L.), L. *Prep.* (Ph. L.) Fresh rue (bruised), caraways, and laurel berries, of each, 1½ oz.; prepared sagapenum, ½ oz.; black pepper, 2 dr.; honey, 16 oz.; water, q. s.; rub the dry ingredients to a fine powder, then add, gradually, the sagapenum, previously dissolved in the water and honey over a slow fire, and mix well. In the Ph. L. 1836 dried rue was ordered. Carminative and antispasmodic. In flatulent colic, and in the convulsions of children, when there is no inflammation.—*Dose*, 15 to 60 gr.; either by the mouth, or made into enema with gruel.

Confection of Scammony. *Syn.* CONFECTIO SCAMMO''NII (B. P.), ELECTUA''RUM SCAMMO''NII (Ph. D.) *Prep.* (B. P.) Scammony, in fine powder, 24 parts; ginger, in fine powder, 12 parts; oil of caraway, 1 part; oil of cloves, ½ part; syrup, 24 parts; clarified honey, 12 parts;

rub the powders with the syrup and the honey into a uniform mass, then add the oils and mix. —*Dose*, 10 to 30 gr.; as a warm cathartic, and in worms, &c.

Confection of Scurvy Grass. (P. Codex.) Fresh leaves of scurvy grass, 1 oz.; sugar, 3 oz. Beat to a pulp and pass through a hair sieve.

Confection of Senna. *Syn.* LEN′ITIVE ELEC′TUARY, ELEC′TUARY OF SENNA; CONFEC′TIO SEN′NÆ (Ph. L. and D.), ELECTUA″RIUM SEN′NÆ (Ph. E.), L. *Prep.* 1. Senna, 8 oz.; corianders, 4 oz.; rub them together, and by a sieve separate 10 oz. of the mixed powder; also boil figs, 1 lb., and fresh liquorice, bruised, 3 oz., in water, 3 pints, until reduced to one half; press, strain, and evaporate the strained liquor in a water-bath to 24 fl. oz.; then add sugar, 2½ lbs.; dissolve, and further add prepared tamarinds, cassia, and prunes, of each, ½ lb.; remove from the heat, and when the whole has considerably cooled, add the sifted powder, by degrees, and stir until the whole is thoroughly incorporated.

2. (Ph. E.) Senna, 8 oz.; corianders, 4 oz.; liquorice root, 3 oz.; figs and pulp of prunes, of each, 1 lb.; white sugar, 2½ lbs.; water, 3½ pints.

3. (Ph. D.) Senna leaves, in fine powder, 2 oz.; corianders (in fine powder), 1 oz.; oil of caraway, ½ dr.; mix, and add them to pulp of prunes, 5 oz.; pulp of tamarinds, 2 oz.; brown sugar, 8 oz.; water, 2 fl. oz.; previously brought to a smooth paste by the heat of a water-bath.

4. (Ph. B.) Boil figs, 12 oz., and prunes, 6 oz., gently in distilled water, 24 oz., in a covered vessel for hours, then, having added more distilled water to make up the quantity to 24 fl. oz., add tamarinds, 9 oz., and cassia pulp, 9 oz.; macerate for 2 hours, and press the pulp through a hair sieve, rejecting the seeds, &c. Dissolve refined sugar, 30 oz., and extract of liquorice, ¾ oz., in the mixture with a gentle heat; and while it is still warm, add to it gradually senna in fine powder, 7 oz., and coriander in fine powder, 3 oz., and stir diligently until all the ingredients are thoroughly combined. The resulting confection should weigh 75 oz.

Uses, &c. Confection of senna is a gentle and pleasant purgative, and well adapted for persons suffering from piles, and as a laxative during pregnancy. The dose is 1 dr. to ½ oz., taken at bedtime or early in the morning.

Obs. There is no one pharmacopœial preparation which it is more difficult to obtain of good quality than confection of senna. The absolute cost of an article prepared according to the directions of the Pharmacopœias is greater than the price at which many wholesale houses are vending the drug. Dr Paris very truly remarks, that "the directions of the Pharmacopœia are very rarely followed." Considerable quantities are manufactured, into which unsound and spoilt apples enter as a principal ingredient; whilst the substitution of jalap for the whole or a portion of the senna is a very common practice. We have seen the following forms employed in the trade:

5. Powdered senna, pulp of tamarinds, cassia, and prunes, of each, 1½ lb.; powdered corianders, ¾ lb.; Spanish juice, ½ lb.; simple syrup, 12 lbs.

6. As the above, but omitting the cassia pulp, and adding 2 lbs. more tamarind pulp. Both these articles are labelled 'P. L.,' and sent out as genuine, and that when no competition as to price exists. The cheaper is made as follows:

7. Common prunes and tamarinds, of each, 16 lbs.; treacle, ¾ cwt.; species (a compound of senna dust and small senna, mixed with 3 lbs. of coriander seeds, and strengthened with jalap; all ground to a fine powder), 18¼ lbs. To this is frequently added, rotten or inferior apples, ¼ cwt., which are pulped with the prunes and tamarinds. This article is commonly labelled 'CONF. SENNÆ VER.' by its manufacturer.

Confection of Sponge. *Syn.* ELEC′TUARY OF BURNT SPONGE; CONFEC′TIO SPONGII, C. S. US′TÆ, L. *Prep.* 1. Burnt sponge, 3 parts; confection of orange peel and hips, of each, 1 part; simple syrup, q. s.

Confection of Steel. *Prep.* 1. CON′FECTIO FER′RI SESQUIOX′IDI, L.—*a.* From confection of orange and sesquioxide of iron (Ph. L.), of each, 2 oz.; white sugar, 3 oz.; syrup, 1½ oz.; mix.—*Dose*, 1 dr. to 3 dr.

2. CONFEC′TIO FER′RI TARTARIZA′TI. (St B. Hosp.) Cream of tartar, 1½ oz.; tartrate of iron, 2 dr.; ginger, 1 dr.; treacle, 2½ oz., or q. s. —*Dose*, 1 dr. to 2 dr. 2 or 3 times daily.

Confection of Sul′phur. *Syn.* BRIMSTONE AND TREACLE; CONFEC′TIO SULPHU′RIS, L. *Prep.* 1. Sublimed sulphur, 2 oz.; treacle, 4 oz.—*Dose.* A spoonful night and morning for a week or longer, as an alterative or purifier of the blood; in skin diseases, &c.

2. (St B. Hosp.) Sulphur, 200 gr.; cream of tartar, 50 gr. to 1 oz.; treacle, as the last.

3. (B. P.) Sublimed sulphur, 4 oz.; cream of tartar, 1 oz.; syrup of orange peel, 4 fl. oz.; tragacanth powder, 18 gr.—*Dose*, 1 to 2 dr.; as a laxative, in piles, gonorrhœa, &c.

Confection of Turpentine. *Syn.* CON′FECTIO TEREBINTH′INÆ, L. *Prep.* (B. P.) Oil of turpentine, 1 fl. oz.; liquorice powder, 1 oz.; triturate together, then add clarified honey, 2 oz. —*Dose*, ½ to 2 dr. for worms.

Confection of Worm-seed. *Syn.* CONFEC′TIO CIN′Æ, C. S. CINÆ, L. *Prep.* 1. (Ph. Slesvico-Holsat. 1831, and Ph. Suec. 1845.) Worm-seed, 2 oz.; heat it in a pan over a gentle fire, add white sugar, boiled to a low candy height, 4 oz.; and stir together until they become dry; then pick out those seeds which are covered with sugar, and repeat the process with the others.

2. Powdered worm-seed and syrup of orange peel, equal parts.—*Dose*, 1 to 2 dr. night and morning, followed by a brisk purge; in worms.

CONFEC′TIONERY. See CANDIES, DROPS, LOZENGES, SUGAR, &c.

CONGELATION. The conversion of a substance from the fluid to the solid state by the abstraction of heat. See ICE and REFRIGERATION.

CONGESTION. "A common condition of disease in an undue flow of blood into any part, or accumulation within it. The vessels seem to lose the power of emptying themselves, which they possess in health. Two forms of it are distinguished, active and passive. The first is when some excitement causes the blood to pass more

rapidly into a part than its vessels can transmit out of it; the second when from some inherent debility the vessels cannot get rid of the fluid ordinarily thrown into them. Congestion of organs disturbs their functions, and through them the general health."

CONGLU'TINUM (Bracy Clarke's.) Sulphate of zinc (white vitriol), 4 oz.; dissolved in water, 1 pint. Used as an astringent lotion in veterinary practice, and much diluted with water (a dessert-spoonful to ¼ pint or more of water), as a collyrium in chronic inflammation of the eyes.

CO'NIA, $C_8H_{17}N$. *Syn.* CO'NINE, CON'ICINE. An alkaloid, discovered by Gieseke in hemlock. It exists in every part of the plant, but is present in the largest quantity in the seed.

Prep. (*Gieger.*) The seeds of hemlock, or their alcoholic extracts, is distilled with water and potassium hydrate. The conia passes over into the receiver and floats on the top of the water, which also contains a little conine in solution. It is purified in the way directed for the volatile bases. (See ALKALOID.) When the alcoholic extract is employed, about half its weight of potash should be used.

Prop., &c. Pure conia is an oily-looking liquid smelling intensely of hemlock, or rather of a combination of the odours of tobacco and mice; volatile at common temperatures; blues red litmus; boils at about 340° F., but readily distils over with water at 212°F.; sp. gr. ·89; with the acids it forms salts, some of which are crystallisable. 6 lbs. of fresh and 9 lbs. of dried seeds yielded 1 oz. of conia (*Gieger*). 40 lbs. of the ripe but green seeds yielded 2½ oz. of hydrated conia (*Christison*).

Conia is remarkably poisonous. 1 drop, placed in the eye of a rabbit, killed it in 9 minutes; 5 drops, poured into the throat of a dog, killed it in less than a minute. It has been employed in some convulsive and spasmodic diseases, but is now seldom used medicinally. "The patient cries, the contortions, and the rigidity of the limbs which have always preceded death (caused by conia), leave no doubt as to the cruel pains which this kind of poisoning brings on" (*Boutron-Chalard* and *Henry*). The treatment may be that recommended under ACONITE and HEMLOCK.

CON'SERVE. *Syn.* CONSER'VA, L. Recent vegetable matter, as flowers, herbs, roots, fruit, and seed, beaten with powdered sugar to the consistence of a stiff paste, so as to preserve them as nearly as possible in their natural freshness. Conserves are made both by the confectioner and the druggist; by the first as SWEETMEATS; by the other chiefly as vehicles for more active medicines. The London College of Physicians now includes both conserves and electuaries under the general head of CONFECTIONS. The term appears, however, in some cases, scarcely appropriate. The word confection has a more general application, and implies any sweetmeat or composition in which sugar is the principal ingredient. See CONFECTION and ELECTUARY.

Conserve of Al'monds. See CONFECTIONS.

Conserve of Angeli'ca. *Syn.* CONSER'VA ANGEL'ICÆ, L. *Prep.* (*Giordano.*) Fresh angelica root, 2 parts; water, 16 parts; macerate for a few hours, clarify the liquor, add sugar, 3 parts; cook the root in the syrup, and preserve it in this state (confection), or dry it (to a candy). Used as an agreeable tonic, stomachic, and carminative.

Conserve, Antiscorbu'tic. *Syn.* CONSER'VA ANTISCORBU'TICA, L. *Prep.* (*Selle.*) Horse-radish, water-cress, and water-trefoil, orange-juice, and radish-juice, equal parts; powdered white sugar, q. s. to make a conserve. In scurvy, &c.

Conserve of A''rum. *Syn.* CONSER'VA A''RI, C. A. MACULA'TI, L. *Prep.* From fresh arum tubers (cuckoo-pint or wake-robin), ½ lb.; sugar, 2½ lbs. As a diuretic and attenuant in dropsy, or as an expectorant in chronic coughs.—*Dose*, ½ teaspoonful, gradually increased.

Conserve of Broom. *Syn.* CONSER'VA SCOPA''RII, L. *Prep.* (*Van Mons.*) Broom flowers, 1 part; sugar, 2 parts.—*Dose*, ½ to 2 teaspoonfuls 2 or 3 times a day; in dropsy, gout, rheumatism, &c.

Conserve of Hips. See CONFECTION.

Conserve of Lavender. *Syn.* CONSER'VA LAVENDU'LÆ, L. Lavender flowers, 1 part; powdered lump sugar, 3 parts; beaten together to a smooth paste. Used to sweeten the breath. In a similar way conserves are made from various other leaves and flowers; but mostly with only twice their weight of sugar, when they are not very odorous or active.

Conserve of Lem'on Peel. *Syn.* CONSER'VA LIMO'NIS, C. L. CORT'ICIS, L. As CONFECTION OF ORANGE PEEL.

Conserve of Mal'lows. *Syn.* CONSER'VA MAL'VÆ, L. From the flowers, as CONSERVE OF LAVENDER.

Conserve of Or'ange Peel. See CONFECTION.

Conserve of Pep'permint. See CONFECTION.

Conserve of Rose'mary. *Syn.* CONSER'VA ROSMARI'NI, L. As CONSERVE OF LAVENDER.

Conserve of Roses. 1. See CONFECTION.

2. (ACIDULA'TED CONSERVE OF ROSES; CONSER'VA RO'SÆ AC'IDA, L.) *Prep.* (Hosp. F.) Confection of roses and powdered gum, of each, 1 oz.; sulphuric acid, 1 to 1½ dr.; (diluted with) water, 2 dr. An excellent substitute for tamarinds.

Conserve of Sav'in. *Syn.* CONSER'VA SABI'NÆ, L. *Prep.* (Ph. Han.) Fresh savin, 1 part; sugar, 2 parts. As an emmenagogue, in amenorrhœa, &c. 3 parts of sugar make a better conserve.

Conserve of Scurvy Grass. *Syn.* CONSER'VA COCHLEA''RIÆ, C. C. HORTEN'SIS, L. *Prep.* (Ph. Aust. 1836.) Fresh scurvy grass, 1 lb.; sugar, 3 lbs. Stimulant and antiscorbutic.

Conserve of Sea Worm'wood. *Syn.* CONSER'VA ABSINTH'II MARITI'MI, L. *Prep.* (Ph. L. 1788.) From sea wormwood, as the last. As a stomachic bitter and vermifuge; in dyspepsia, &c.

Conserve of Sloes. *Syn.* CONSER'VA PRU'NI SYLVES'TRI, L. *Prep.* (Ph. L. 1788.) From the pulp of the fruit, 1 part; sugar, 3 parts. Astringent. Useful in simple diarrhœa, &c.; either alone or combined with chalk.

Conserve of Squills. *Syn.* CONSER'VA SCIL'LÆ, L. *Prep.* (Ph. L. 1788.) Fresh squills, 1 oz.; sugar, 5 oz. Diuretic, attenuant, and expectorant; in dropsy, chronic coughs, &c.—*Dose*, 10 to 20 gr.

Conserve of Tam′arinds. *Syn.* CONSER′VA TAMARIND′ORUM, L. *Prep.* (P. Cod.) Tamarind pulp, 2 oz.; white sugar, 3 oz.; evaporate by the heat of a water-bath to the consistence of honey.

Conserve of Vi′olets. *Syn.* CONSER′VA VIO′LÆ, C. V. ODORA′TÆ, L. *Prep.* (*Soubeiran.*) Flowers, 1 part; sugar, 3 parts; beat to a paste. Demulcent and laxative; used as a purge for infants, and by ladies to perfume the breath.

Conserve of Worm′wood. See CONSERVE OF SEA WORMWOOD.

CONSTIPA′TION. *Syn.* CONSTIPA′TIO, OBSTIPA′TIO, L. Surgeons distinguish between costiveness and constipation. The first applies to that condition of the body in which the bowels act tardily, and in which the fæces are abnormally and inconveniently indurated; the last implies the absence of the proper alvine evacuations. The one rapidly undermines the health; the other destroys life in a period varying from a few days to 3 or 4 weeks. In popular language, however, the words are frequently used synonymously. The use of bread containing alum, and water containing much lime (very hard water), and especially the want of sufficient exercise, are common causes of constipation.

Treatm. When the affection is merely accidental or occasional, a dose of some aperient or cathartic is the only treatment necessary; but when it is habitual it calls for further attention. Great benefit may generally be secured by adopting a diet free from astringents, and consisting of a large portion of green vegetables and ripe fruit; particularly avoiding the use of over-cooked, salted, or dried animal food. Brown bread may be eaten, as it acts as a gentle laxative from the bran it contains. The occasional use of aperient and emollient enemata, especially glycerine, may be had recourse to; but their habitual administration, as well as that of purgative medicines generally, by the mouth, is not to be recommended. The bowels, accustomed to the continued use of stimulants, act but languidly or scarcely at all without their application. In females, especially of the higher classes, the want of proper exercise is commonly the chief cause of this affection. With such persons a short walk, 2 or 3 times daily, will often do wonders, particularly if a little ripe fruit, a few raisins or tamarinds, or, still better, 2 or 3 drum figs, be occasionally eaten. The habit of attempting the evacuation of the bowels regularly every day at the same hour will often be attended with the most excellent results, and a glass of cold water taken immediately on rising in the morning will generally cause an evacuation in an hour or two. In some cases of obstinate constipation a cold-water dressing, placed over the pit of the stomach or the abdomen, will cause the bowels to act in the course of an hour or two. When the inactivity of the bowels arises from a deficiency of bile (one of the most common causes), no remedy is more natural, or more effective, than inspissated ox-gall. In cases complicated with nervous, hypochondrical, or hysterical affections, in chlorosis, dyspepsia, depraved appetite, and numerous other ailments, this remedy frequently succeeds, after the most active articles of the materia medica have been tried in vain.

In the treatment of the constipation of infants, castor oil ($\frac{1}{2}$ teaspoonful occasionally), or manna, $\frac{1}{4}$ to $\frac{1}{2}$ oz., sucked at will, may be given. The introduction (very gently) of a little slip of writing-paper, parsley stalk, or soap, is a method sometimes adopted successfully by nurses. Friction on the stomach and bowels with the warm hand, or a piece of soft flannel, should also be employed. See GALL, PURGATIVE, &c.

Treatm. for Animals. Mr Finlay Dun prescribes laxative clysters, aloes, or oils. Calomel for horses; croton and gamboge for cattle. Salts, calomel and jalap, castor oil, linseed oil, and emetics, for carnivora. Oil of turpentine by mouth or rectum.

Treatm. for Horses. When the animal is constipated administer 4 dr. of aloes and 1 dr. of calomel, rubbed down with gruel; inject soap and water every hour, taking care to let the horse have walking exercise, and to apply friction to the belly. If, after 12 hours, no effect is produced, let the aloes and calomel be repeated with the addition of 3 or 4 drops of croton oil and a wine-glassful of spirit of nitre, ether, gin, or whisky.

The same care should be exercised with animals as with the human subject. Horses and cattle over-abundantly fed are liable to impaction of the colon, and in these cases drastic purgatives are very dangerous as liable to cause rupture of the intestine.

CONSTITUTION BALLS, Vegetable. (*A. H. Böldt.*) Two parallelopiped hard brown balls, each of which weighs 58 grms., and is made by melting together 2 parts of aloes and 1 part coarsely powdered gentian (*Hager*).

CONSUMP′TION. See PHTHISIS.

CONTA′GION. By 'contagion' is usually meant the communication of disease by means either of actual contact or through a medium, such as the air. By some a contagious disease is regarded as one arising from direct contact only, in contradistinction to an infectious one, which is believed to act at a distance. See DISINFECTANT.

CONTU′SION. A hurt, or injury to the flesh, such as might be caused by a blunt instrument or by a fall, without breach or apparent wound. For treatment, see BRUISE.

CONVALESCENCE. Convalescence may be described as the period between the cessation of an attack of serious illness and the restoration, if not to a perfect, to an accustomed state of health. Convalescent patients should particularly guard against excess in eating or drinking, or unnecessary and imprudent exposure to cold or damp weather during this interval, as well as against premature exertion of the limbs or voice, each and all of which are acts of imprudence that may give rise to a return of the disease. In order to avoid this latter risk, as well as to aid in complete recovery, repose both of body and mind are generally needed, more particularly in the earlier stages of convalescence.

It should be borne in mind that convalescents from many infectious diseases, such as measles, scarlet fever, smallpox, typhus, &c., are much more likely to propagate these diseases than when they are labouring under them in the acute form. During the period of their recovery the skin and other organs are throwing off the poison in large quantities, and thus exposing those in contact

with, or in the near neighbourhood of, the convalescent, to the great and imminent risk of contagion. Even if not contagious himself, the convalescent's clothes, if they be the same as those worn by him during his illness, may also convey the disease.

A convalescent should always act under the advice of a medical man, and should be careful not to presume too much from mere sensations of restored health and strength. The sequelæ of many diseases are often more permanently injurious than the diseases themselves, and after febrile disorders, especially measles, scarlet and typhoid fevers, the greatest possible care should be taken.

CONVALLARIA. *Syn.* LILY OF THE VALLEY. This plant is the *Convallaria majalis* of the Nat. Ord. LILIACEÆ. It has been in use for ages by Russian peasants as a remedy for dropsy. All parts of the plant contain two active principles of the glucoside class, viz. *convallarin* and *convallamarin.* The latter is the most active. The drug is used in functional and organic disease of the heart, lessening irritability and peevishness.—*Doses.* Extract, 2 to 8 gr.; fluid extract, 2 to 10 minims; tincture, 5 to 20 minims; convallamarin, ½ to 2 gr.

CONVULSIONS. Spasmodic contractions of the muscles, producing motions of the limbs, generally accompanied with unconsciousness. Convulsions occur at all periods of life, but in adults they are only symptoms of other diseases. In children they are very common. They are of frequent occurrence in teething; and a swollen and inflamed state of the gums is said to excite them. A very large proportion of cases are brought on by improper food, *e.g.* the milk of a nurse suffering from some violent emotion. At the siege of Berlin nearly all the suckling children died of convulsions. It is no uncommon thing at our great hospitals for mothers to bring their infants to the out-patient room in convulsions with a piece of cold potato—pork, bacon, apple, or other material deadly to infants of tender years clenched in their fists; and on inquiry as to the child's usual diet, the common reply is: "Oh, it has a bit of something with us." The death of helpless infants through the carelessness and ignorance of their parents is deplorable, and the wonder is that so many survive the treatment to which they are subjected. They may also be induced by feverish attacks, hooping cough, strong purgatives, or suppressed eruptions. In the case of a dangerous attack of convulsions no time should be lost in sending for a medical practitioner. Pending his arrival, the patient should be placed as promptly as possible in a hot-water bath. A better plan is to loosen all the dress, to place the child across the arms, and sway it up and down gently, and to allow cool air to play on the face and chest; give an enema of soap and water, and apply mustard plasters for a few seconds only to the pit of the stomach. If these fail to give relief, apply leeches (number according to the age) to the temples, and cold to the head. Lance the gums if inflamed. Emetics and enemata will be useful if an overloaded stomach and intestines be the cause; small doses of pot. bromide, 10 gr. for adults; less for children and infants according to age, are useful in preventing recurrence of the attacks. When the fit is over keep the head cool. Keep the bowels open by castor oil, and let the patient be put on a milk diet.

COPAHINE. Copaiba balsam made into a mass with wax and powdered cubebs, divided into hard egg-shaped pills weighing 5 decigrms. each and sugar-coated.

COPAHINE MEGE DE JOZEAU. A fixed quantity of copaiba balsam is mixed with concentrated nitric acid, and constantly stirred as long as effervescence continues. The oxidised balsam is then washed, first with warm then with cold water, till the washings cease to have an acid reaction. From one part of this balsamum copaivæ acido nitrico correctum with 1-10th part powdered cubebs, 1-10th part bicarbonate of soda, 1-16th part calcined magnesia, with some mucilage, a mass is prepared and divided into oval pills, which are afterwards coated with sugar, mixed with gum and carmine.

COPAI'BA. *Syn.* COPAI'VA, COPAIVA BALSAM, CAPIV'I, BALSAM OF CAPIV'I; COPAI'BA (Ph. L. E. & D.), L.; BAUME DE COPAHU, Fr.; COPAIVA BALSAM, Ger. "The oleo-resin, of a brown colour, obtained by incision from the trunk of *Copaifera Langsdorffii*" (B. P.). Most of the balsam of commerce is obtained from Para and Maranhao. It is packed in casks containing from 1 to 1½ cwt. each, or in large bottles, or in cylindrical tin boxes.

Prop., Purific., &c. Copaiba, though usually called a 'balsam,' is not correctly so named, as it contains no benzoic or cinnamic acid. It is correctly described in the B. P. as an 'oleo-resin.' Considerable variation exists in the colour, odour, consistence, and transparency, as well as in the proportion of oil and resin yielded by different samples, scarcely any two of which exactly agree. The sp. gr. varies from 940 to 993. Brazilian copaiba is thin, clear, and pale; whilst the West Indian variety is thick, golden yellow, less transparent, and has a less agreeable and somewhat terebinthinate smell. Some varieties are opaque, and continue so unless filtered. This is often a most troublesome operation. The opacity generally arises from the presence of water, which it retains with great tenacity. The following is the plan we have found to answer for clearing it on the large scale:—Place the casks upon their ends in a warm situation, and leave them so for 10 days or a fortnight, or longer if convenient. They may then be tapped a little above the bottom, when the contents of some of them will generally be found quite transparent, and may be drawn off and vatted, care being taken to avoid shaking up the bottom. The copaiba that remains foul must be filtered through one or more long Canton flannel bags sunk in the bottom of a tin cistern, placed over a suitable receiver, in a similar way to that adopted for oils, a few pounds of coarsely-powdered charcoal being mixed up with the first 5 or 6 gallons thrown in. This will rapidly fill up the pores of the bag, and make the balsam soon flow clear and pale. The 'bottoms' of the casks, containing the water and impurities, may be poured into a large can or jar, and allowed to settle for a few days, when the copaiba may be poured off the top and filtered. A sudden change

of temperature will frequently turn a transparent sample of this article opaque or milky; it is not, therefore, deemed fit to send out by the wholesale trade, unless it stands this test. To ascertain this point a common practice is to fill a small bottle with the copaiba, and to leave it out of doors all night in an exposed situation.

Pur., Tests, &c. This substance is frequently adulterated. This is particularly the case with that sold in capsules, at low prices, in the shops. Pure balsam of copaiba may be recognised by the following characters:

1. (Ph. E.) It is transparent; free of turpentine odour when heated; soluble in 2 parts of alcohol; and dissolves one fourth of its weight of carbonate of magnesia with the aid of a gentle heat, and continues translucent.

2. (*Chevallier.*) A drop of the balsam, placed on a piece of unsized paper and heated until all the essential oil is expelled, forms a semi-transparent, well-defined spot; but if the balsam has been adulterated with a fatty oil, it is surrounded by an oily areola.

3. (*Planche.*) $2\frac{1}{2}$ parts of balsam shaken with 1 part of solution of ammonia, sp. gr. ·965, forms a mixture which becomes clear and transparent in a few moments, and may be heated to 212° F. without becoming opaque.

4. (*Vigne.*) Boiled with 50 times its weight of water for 1 hour, it should lose at least half its weight.

5. (*Adder.*) By agitating the suspected sample with a lye of caustic soda, and setting the mixture aside to repose, the balsam after a time rises to the surface, and the fatty oil present (if any) forms a soapy, thick mass below.

6. ('Journ. de Pharm.,' 1842.) Pure copaiba may be adulterated with 50% of a fat oil (nut, almond, or castor oil), without it ceasing to give a clear solution with 2 parts of alcohol; but it combines badly with magnesia and ammonia. Excess of alcohol, however, separates the oil in all cases. It was formerly considered that the best test for detecting the fat oils was pure alcohol, to which some caustic potash had been added.

7. (*Dr Hager.*) Copaiba which is adulterated with Gurgun balsam is not quite clear, and frequently exhibits prisms of gurginic acid under the microscope. The author states that the adulteration may be easily detected by mixing the suspected sample with 4 volumes of petroleum ether; the mixture at once becomes turbid, and gradually deposits a sediment, which, after $\frac{1}{2}$ hour's settling, occupies the same volume as the copaiba operated upon. A mixture of pure copaiba with petroleum ether is clear at first, and either remains clear upon standing, or it deposits after several hours a very slight sediment, which merely covers the bottom of the test-tube like a thin film. Benzol may be used in place of petroleum ether.

8. (*Muter.*) Three or 4 grms. of the sample are weighed into a clean, dry flask, and saponified on the water-bath with 50 c.c. of alcohol, and a lump of caustic soda weighing not less than 5 grms. When all is dissolved water is added, and the whole washed into a $\frac{1}{2}$ pint basin, so as to nearly fill it, and evaporated to 100 c.c. over a low gas flame. Dilute sulphuric acid is then added till the whole just becomes permanently turbid, and then solution of caustic soda is dropped in till it just clears again. By this means a solution is obtained with the least possible excess of alkali, and with a good amount of sodium sulphate. The whole is now to be evaporated to *perfect dryness* on the water-bath, stirring towards the end, so that the sulphate may mix with the soaps, and produce an easy pulverulent residue. The residue is moved from the basin into a small, wide-mouthed, stoppered bottle, treated with 70 c.c. of ether-alcohol, and well shaken up. As soon as it is fairly settled the fluid is filtered off through a *quick* filter, and this is repeated with two successive quantities of 70 c.c., making 210 c.c. in all of the solvent used. The residue in the bottle and in the filter now consists of sodium oleate and sulphate if the balsam be impure, and of the latter only if pure, with a little trace of the insoluble resin soap already referred to. The contents of the bottle and filter are then dissolved in warm water, and after heating until all smell of ether is gone the whole is boiled freely acidulated with acid, and set to cool.

If, when cold, nothing but a few specks of brown resin should rise to the surface, the balsam is pure; but if an oily layer be formed it is adulterated, and the smell of the separated oleic acid will at once determine whether it is actually castor oil or not.

In the case of the presence of oil, 2 grms. of pure and dry white wax are added, and the whole heated till the wax melts with the oleic acid. On cooling, a solid cake is formed, which is detached from the side of the beaker, and the fluid below passed through a filter. The cake is once more melted in boiling water, cooled, detached, dried by gentle pressure between blotting-paper, dried in a water-oven in a weighed platinum dish, and then weighed, and the weight of the wax used deducted. The beaker, filter, rod, &c., used are, if at all dirty, dried, extracted with ether, and the residue left, after evaporation, weighed and added to the total.

The calculation is then performed as follows:

(1) To the weight in grms. found add ·20 for the loss of oleic acid in solvent, and then say as 95 : 100 : : total oleic acid.

(2) Calculate the percentage from the quantity taken, and from this deduct 6% for possible altered resin in the balsam. The error, owing to the correction, of course, increases with the amount of oil present; but it is stated to be always an error in the direction of under-estimation, which is the great point for public analysts. When working on 3 to 4 grms. with an admixture of not over 25%, the errors due to loss of oleic acid and insoluble resin soap are said to so nearly balance each other that any correction is unnecessary, and the actual amount of oleic acid found may be taken as correct within 1%.

9. (B. P.) According to the British Pharmacopœia, copaiba should be soluble in an equal bulk of benzol.

10. (The evaporation test.) Mr Siebold says: "This is an excellent and exceedingly simple test, but is clumsily applied by many. Instead of boiling the balsam with water for many hours, a small quantity (about 1 to 1·5 grm.) of the sample should be carefully heated in a watch-

glass until all the oil is driven off, which is the case as soon as the residue has assumed a rich brown colour. A few minutes suffice for the experiment.

"If the remaining resin is perfectly brittle and pulverisable there is no fatty matter present, for 1% of oil would diminish the brittleness of the resin, so that it cannot be reduced to a fine powder. 1% of oil is thus readily detected, and with larger quantities of the adulterant (3% to 5%) the resin feels quite sticky.

"On heating the resin castor oil and linseed oil may be distinguished by the odour. By mixing the adulterated balsam with 10, 20, 40, and 50 volumes of pure maranham balsam respectively, and testing each dilution in this manner, it is possible to find in which the oil has been reduced to below 1%, and thus to ascertain whether the adulterant amounted to 10%, 20%, 30%, 40%, or 50%, and this, I think, would be sufficiently near the mark for the purpose of public analysts."

Uses, &c. Balsam of copaiba is diuretic and astringent; and appears to possess a sort of specific power over diseases of the mucous membranes of the urino-genital organs. It is hence a favourite remedy in gonorrhœa, as soon as the first inflammatory symptoms have subsided. Useful in chronic bronchitis where there is excessive mucous secretion. *Dose*, 20 to 60 drops on sugar, floating on water, or made into an emulsion with the yelk of egg or gum-arabic, 3 or 4 times daily, if the stomach will bear it. The addition of a few drops of sweet spirits of nitre and laudanum have been recommended, to allay the nausea. By adding 1 dr. of oil of orange (ol. aurantii) to each oz. of the balsam, its flavour becomes far from disagreeable, and it sits well upon the stomach. Copaiba is also given in capsules and pills. See CAPSULES, EMULSION, OIL, PILLS, &c.

Obs. Numerous preparations of this article are sold under such names as 'soluble copaiba,' 'specific solution,' 'salt of copaiba,' &c.; none of these appear to possess equal activity and certainty of operation to the natural balsam. As the whole virtue of copaiba as a medicine depends on the essential oil it contains, the value of any of these preparations may be estimated by the quantity of that article which is found in them. In the case of the first two articles above named the quantity is very small indeed, and in the last it is wholly deficient.

The following forms are current for the reduction (adulteration) of balsam of capivi:

1. Balsam of copaiba, 4 lbs.; castor oil, 3 lbs.; mix well.

2. Balsam, 7 lbs.; castor oil, 4 lbs.; yellow resin, 2 lbs.

3. Equal parts balsam of copaiba and Canada balsam.

4. To the last add Venice turpentine, 1 lb.

5. Balsams of Canada and copaiba and nut or castor oil, equal parts.

6. Copaiba, 7 lbs.; nut oil, 3 lbs.; yellow resin, 2 lbs.; Canada balsam, 1 lb. Used to fill the cheap capsules; and to sell in the lower parts of London, and in the manufacturing districts. See also COPAIBA, FACTITIOUS (*below*).

Copaiba, Facti''tious. *Syn.* COPAI'BA FACTI''TIA, BAL'SAMUM COPAI'BÆ FACTI''TIUM, L. *Prep.* 1. Castor oil (warm), 7 quarts; copaiba bottoms, 1 quart; mix, and filter through flannel.

2. Castor oil, 1 gall.; yellow resin, 3 lbs.; Canada balsam, 2 lbs.; oil of juniper, 2 oz.; oil of savin, 1 oz.; essences of orange and lemon, of each, ½ oz.; powdered benzoin, 1 oz.; melt the resin with the castor oil and benzoin, and when nearly cold add the essences.

3. Canada balsam, 9 lbs.; castor oil, 7 lbs.; yellow resin, 1 lb.; Venice turpentine, 2 lbs.; oils of rosemary, juniper, and savin, of each, 1 dr.; essential oil of almonds, 20 drops.

4. Canada balsam, 3 lbs.; Venice turpentine, 1 lb.; oils of fennel, juniper, and savin, of each, q. s.

Used chiefly to fill capsules. It is readily distinguished from balsam of copaiba by the proper tests. (See *above*.) Train oil or nut oil is frequently substituted for the castor oil.

Copaiba and Ka'li. *Syn.* COPAIBA CUM POTASSÂ, L. *Prep.* Carbonate of potassium and water, of each, equal parts; dissolve, add gradually, transparent balsam of copaiba, until the fluid, at first milky, turns quite clear. Resembles miscible copaiba (see *below*).

Copaiba, Miscible. *Prep.* From balsam of copaiba (pure and transparent), mixed with half its volume of solution of potassa made of double the strength ordered in the B. P.

Obs. As different samples of copaiba often require slightly different quantities of the solution of potassa, it is best to mix the two gradually and cautiously together. Should the mixture be opaque, a little more of one or other of the ingredients, as the case may be, will render it clear. No heat must be used. This article is miscible with water, with which it forms a kind of milk; and, from containing all the volatile oil of the copaiba, is a very valuable preparation. Its activity is considered equal to that of the balsam itself, and it is given in similar doses.

Copaiba, Sol'uble. *Syn.* COPAI'BA SOLUBIL'IS, L. *Prep.* 1. Heat miscible copaiba in an earthen, glass, or bright-tinned copper vessel to nearly the boiling-point, pour it while still hot in a separator, cover it up, and allow it to cool very slowly. After a few days, draw off the clear portion from a cork or hole placed at or near the bottom of the vessel observing to reject the first few drops which pass through, and to stop the stream before any of the floating oil (*oleum copaibæ*) reaches the orifice. A very little concentrated liquor of potassa, added before applying the heat, renders it more soluble. Thick, transparent, soluble in pure water, and resembles the natural balsam in appearance.

2. Balsam of copaiba and solution of potassa (B. P.), equal parts, by volume; mix, boil for a few minutes, and then proceed as before. Thinner than the last.

Prop. Less powerful than miscible copaiba, but it sits better on the stomach, and is about 4 times as strong as specific solution of copaiba. See SOLUTION.

Copaiba, Resin of. *Syn.* COPAI'BÆ RESINA, L. The residuum of the process of distilling the oil of copaiba from the balsam. It consists

principally of copaibic acid. It has been recommended for gonorrhœa, but is nearly inert, even in ½ oz. or ¾ oz. doses. See OIL.

Copaiba, Salt of. *Syn.* SAL COPAI'BÆ, L. There are two preparations sold under this name; the one, crude copaibic acid; the other, copaibate of an alkali. Neither of them possesses the valuable properties of copaiba, which reside almost entirely in its essential oil. "We have taken the 'sal copaibæ,' and have watched its action on others, but have not been able to perceive any good effects to result from its administration" (*Cooley*).

COPAI'BIC ACID. *Syn.* CAPI'VIC ACID, YELLOW RESIN OF COPAIBA. An amber-coloured, brittle, semi-crystalline, resinous substance, obtained from resin of copaiba, soluble in alcohol, rectified spirit, ether, and oils, reddens litmus paper, and forms salts with the bases, called copaibates. That of the shops is often of a green colour, due to copper from the vessels in which the copaiba has been heated. Dr G. Wilks asserts it is a good diuretic.

CO'PAL. *Syn.* COPAL', GUM COPAL. A resinous substance, which exudes spontaneously from various trees belonging to the genera *Hymenæa, Guibourtia,* and *Trachylobium.* The varieties commonly met with in commerce are East Indian copal, or anine, which is the produce of *Hymenæa courbaril,* and West Indian copal, obtained from numerous species.

Prop. When of good quality it is too hard to be scratched by the nail, has a conchoidal fracture, and a sp. gr. ranging from 1·059 to 1·072. Unlike other resins, it is dissolved with difficulty by alcohol and essential oils; and this property, combined with its extreme hardness, renders it very valuable for making varnishes. See VARNISH.

COP'PER, Cu = 63·1. *Syn.* CU'PRUM, L.; CUIVRE, Fr.; KUPFER, Ger. A metallic element not belonging to any very well-marked group, but somewhat resembling silver and mercury, and, to a less extent, gold in its properties.

Sources. Metallic copper (native copper) is found in many parts of the globe, diffused in isolated particles in the form of thin laminæ, in loose grains intermixed with quartz (copper sand, copper barilla), in dendritic pieces, and in solid blocks, occasionally of many tons weight. The richest deposits of native copper are those of Lake Superior, in North America. More frequently and more abundantly it occurs as an ore, *e.g.* red oxide (Cu_2O), black oxide (CuO), green carbonate of copper or malachite ($CuCO_3 + Cu(OH)_2$), blue carbonate of copper or azurite ($2CuCO_3 + Cu(OH)_2$,KCn_2S), vitreous sulphide of copper, indigo copper (CuS), purple copper (Cu_3FeS_3), copper pyrites, or yellow copper ore ($CuFeS_2$), with sulphur, antimony, or arsenic, and other metals (true grey copper ore or fah'lerz), as an impure hydrated silicate (chrys'ocolla) ($CuScO_3 + 2H_2O$), and as an impure hydrated oxychloride (atac'amite) ($CuCl_2 + 3Cu(OH)_2$). The most abundant and important ore is copper pyrites. It is principally obtained from the mines of Cornwall, Devonshire, and Cuba. The carbonates of copper are now largely imported from Australia; the metal produced by smelting them is generally of the best quality.

Prep. There are several different methods by means of which copper is extracted from its ores. Of these we shall first describe the most important, viz.:

THE COMMON OR WELSH PROCESS. This process includes six distinct operations, as follows:—1. The ore (copper and iron pyrites), containing from 8% to 10% of copper, together with iron, sulphur, and silica, is roasted in a reverberatory furnace, called a 'calciner,' by which much of the sulphide of iron is converted into oxide. 2. The calcined ore is melted with 'metal slag' (a product of a subsequent operation—No. 3), in a melting furnace called the 'ore-furnace.' The products are a regulus, termed 'coarse metal,' containing about 35% of copper, and 'ore-furnace slag,' which is thrown away. Much of the iron, and the whole of the so-called earthy matter of the ore, are thus separated as slag. 3. The coarse metal, having been granulated by causing it to flow from the furnace into water, is calcined with free access of air in a calciner, and a considerable amount of sulphur is expelled. 4. The calcined, granulated, coarse metal is melted with the addition of matters rich in oxides of copper, namely, 'roaster' and 'refinery slags' (from the two remaining operations, Nos. 5 and 6 respectively), and native carbonates of copper, or ores containing oxide of copper. The products are a regulus termed 'metal,' which is nearly pure copper sulphide (Cu_2S), containing about 75% of copper, and metal slag (see No. 2). The metal should be in the state of 'white metal,' compact and brittle, with a feeble metallic lustre and a dark, bluish-grey colour. It is tapped off into sand-moulds. 5. The pigs of regulus obtained by the last operation are roasted in a furnace through which air passes. The temperature is so regulated that the regulus may be melted in from 6 to 8 hours. The slag is skimmed off, and after a time the heat is lowered, to allow the regulus to solidify. It is again melted and tapped into sand-moulds, the product being called 'blister copper.' 6. This, the last operation, is termed 'refining.' From 6 to 8 tons of blister copper, in pigs, are melted in a furnace and kept exposed for about 15 hours to the oxidising influence of the air. The slag is skimmed off through the end opening. When the oxidation has been sufficiently prolonged, anthracite or free-burning coal, as pure as possible, is thrown upon the surface of the metal, and after a short time the thick end of a long birch or oak pole is plunged into the molten mass. This part of the operation is termed 'poling.' The wood in contact with the copper is rapidly decomposed; much gas is evolved, which causes the metal to be splashed about, and every part of it to be exposed to the reducing action of the coal. When the refiner finds the metal to be at the state of 'tough pitch,' the pole is taken out and the coal pushed back from the end opening, through which the copper is then ladled out as quickly as possible, and cast into suitable moulds. For full details of this and other processes, the reader is referred to Dr Percy's work on 'Metallurgy' and Ure's 'Dictionary of Arts, Manufactures, and Mines.'

THE MANSFIELD PROCESS. By this process

copper and silver are extracted in Germany from a cuprous schist ('Kupferschiefer'), which contains also minute quantities of silver. The schist is first roasted in heaps, by which means bituminous matter is burnt off, and the water and arsenic, and much of the sulphur expelled. The roasted ore is fused in a cupola furnace with from 5% to 8% of slag and fluor spar, the yield being coarse metal and a slag containing very little copper. The coarse metal is calcined and melted, yielding fine metal, which is ground to powder between millstones, and then carefully roasted. The copper is thus mainly converted into an insoluble oxide, whilst the silver is transformed into the soluble sulphate, which is extracted by lixiviation (Ziervogel's process). The remaining mixture of copper oxide and sulphide is fused with slag in a blast-furnace, and a rich black regulus is obtained containing 98% of copper. This is finally purified by melting it in a refining-hearth in contact with charcoal, 'rosette copper' being thus obtained; this must, however, be subjected to a process of toughening if the maximum degree of malleability is required.

THE HYDRO-METALLURGICAL METHOD. One of the oldest processes of this kind is that known as the 'cementation' method, and consists in precipitating copper from a solution of the sulphate of the metal by means of metallic iron. In some mines solutions of the sulphate are met with occurring naturally, in others they are prepared artificially by treating poor ores containing oxide of copper with sulphurous acid or diluted sulphuric acid, and sometimes by roasting copper pyrites and afterwards washing them with water to extract the resulting sulphate. The copper obtained by any of the above processes is called 'cementation copper.' In the Isle of Anglesea the cementation liquid containing the dissolved sulphate of copper is first run into large vessels, where the suspended matters are allowed to subside; from these it is conveyed to tanks containing old scrap-iron, which serves as the precipitating agent. The scrap-iron is occasionally stirred up so as to renew the metallic surface presented to the solution. The muddy liquor, which contains metallic copper as a spongy mass besides impurities, is run into vessels, where it deposits the copper, which, after the removal of the supernatant fluid, is removed and dried in a furnace.

THE WET PROCESS. (*Henderson's* process.) The ores (Spanish and Portuguese pyrites) treated by this method vary very slightly in composition, rarely containing much more than 3% of copper, nearly 50% of sulphur, from 43% to 44% of iron, with small quantities of lead, arsenic, zinc, lime, &c. The ores are first employed by the vitriol manufacturers as a source of sulphuric acid. In the process of burning they lose about 30% of their sulphur. The copper is extracted from the residue by subjecting this latter to the following processes, which are thus described in the 'Encyclopædia Britannica.'

I. *Grinding.* The burnt ore, as received from the acid burners, is first mixed with about 15% of common salt, and ground to a fine powder by passing it between a pair of heavy cast-iron rollers. As the amount of sulphur left in the burnt ore is apt to vary, it is necessary to ascertain its proportion in each parcel of burnt pyrites. When the sulphur falls short of the proportion necessary for effecting the decomposition which follows, a sufficient quantity of 'green' or unburned pyrites is added to produce a proper balance. If, on the other hand, the sulphur has been sufficiently extracted, dead roasted ore is added.

II. *Calcination.* This operation is accomplished in several kinds of furnaces, that used by the Tharsis Sulphur and Copper Company being a large muffle or close furnace. By others a patent furnace with a revolving hearth and mechanical stirring arrangement has been adopted with good results; and some use open reverberatory furnaces heated by gas from Siemens's generators. During the roasting the mixture is frequently stirred, and in the case of hard-worked furnaces turned with long rabbles, and the completion of the operation is ascertained by test assays. When the copper has been brought into a soluble condition, the charge is raked out of the furnace and permitted to cool under a screen at its mouth. By the calcination the sulphur in the compound is first oxidised, sulphate of sodium is formed, and at the same time the chlorine from the sodium chloride unites with the copper to form cupric chloride. A small proportion of cuprous chloride is also formed, and special precautions have to be taken to prevent the extensive formation of this compound, which is dissolved only with difficulty. The hydrochloric acid and other gaseous products evolved during the calcination are condensed as 'tower liquor' in ordinary condensing towers, and the product is used in the subsequent process of lixiviation.

III. *Lixiviation.* The calcined ore is conveyed to tightly caulked wooden tanks, in which it receives repeated washings with hot water, tower liquor, and dilute hydrochloric acid till all the soluble copper is thereby extracted. The product of the latter washings is pumped or drawn up by a modification of Gifford's injector, to serve as a first liquor for subsequent charges of the lixiviating tanks, and no solution under a definite strength is permitted to pass on to the next stage in the process. The insoluble residue in the tanks consist of 'purple ore,' an almost pure ferric oxide, largely used in 'settling' blast furnaces and for smelting purposes; besides which it is available as jewellers' rouge.

IV. *Precipitation.* The precipitation of metallic copper from the solution of its chloride is accomplished in large tanks by means of metallic iron in the same way that cementation copper is obtained from solutions of the sulphate. The solution is run into the tanks in which there are miscellaneous heaps of old malleable iron; the chlorine combined with the copper unites with the iron, and metallic copper in a state of fine division is thrown down. The completion of the precipitation is ascertained by dipping a bright steel knife into the solution in the tank, and when no deposit of copper covers the steel, the liquor is run off and a new charge conveyed into the tank. The tanks are drained periodically for removing the precipitate, which is first roughly separated from the small pieces of iron, after which it is more thoroughly freed from iron, &c., by washing

in water in a rocking sieve apparatus. The precipitate so obtained should contain 80% of metallic copper, which is either smelted directly for blister copper, or may be fused with the white metal of the ordinary smelting process, and subsequently roasted. It has been found possible to extract in this process with profit the small proportions of lead, silver, and gold, which Spanish pyrites is known to contain. Two processes are in operation for this purpose—one devised by Mr P. Claudet, and the other by Mr W. Henderson, the original patentee of the wet process. The liquors from the first three washings contain practically all these metals, and they alone are treated. Mr Claudet precipitates them from the solution by means of iodide of potassium. Mr Henderson dilutes his solution from 20°—25° Tw., and adds a very weak solution of lead salt, such as the acetate, by which he obtains a cream-coloured precipitate containing 5% or 6% of silver, and 3 oz. of gold to each ton of the precipitate. The importance of the wet process may be estimated from the fact, that although it originated only in 1860, already 14,000 tons of copper are annually produced by it in Great Britain alone, out of an annual production for the whole world estimated at from 126,000 to 130,000 tons.

In the laboratory copper is commonly employed under the following forms:

1. Bean-shot Copper. Produced by simply lading the melted copper from the refining furnace into hot water. In small lumps like peas and beans; hence its name. Used to make alloys, solutions, &c.

2. Electrotype Copper. A very pure form, obtained by decomposing sulphate of copper in an electrotype apparatus. It does not contain lead, whereas most varieties of commercial copper do contain that metal.

3. Feather-shot Copper, Granulated Copper. Produced by lading the refined copper from the furnace into cold water. In small pieces, with a feathered edge. Used to make calamine, brass, solution of copper, &c.

4. Copper in Plates or Foil. Those of commerce (best annealed) are generally employed.

5. Copper in Powder. A solution of sulphate of copper is heated to the boiling-point, and precipitated with distilled zinc; the precipitated copper is then separated from the adherent zinc by dilute sulphuric acid, washed with water, and dried by exposure to a moderate temperature.

Prop., &c. Copper has a brilliant yellowish-red colour, a nauseous, styptic taste, and emits a disagreeable odour when rubbed. Next to silver it is the best conductor of heat and electricity known; it is very malleable and ductile; unchanged in dry air; in damp air it soon becomes covered with a greenish rust (carbonate of copper); slightly soluble in dilute sulphuric and hydrochloric acid; freely soluble in boiling oil of vitriol (sulphurous anhydride being evolved); dilute nitric acid dissolves it readily with copious evolution of nitric oxide; heated to redness in the air, it rapidly becomes covered with a black scale (oxide): it fuses at a full red heat; its crystals are either octahedra or dodecahedra; sp. gr. 8·8 to 8·96; it forms numerous compounds (alloys and salts) with other bodies, and all of these are more or less poisonous; its salts are either blue or green, and most of them (when neutral) are soluble in water.

Tests. Metallic copper may be recognised by the above properties, its compounds by the following reactions which are given by their solutions:—1. The solutions exhibit a blue or green colour. 2. Sulphuretted hydrogen gives a brownish-black precipitate, insoluble in dilute acids or in ammonium sulphide, but soluble in warm nitric acid. 3. Caustic potash or soda give a bluish precipitate in a cold solution, a brownish-black one in a hot solution. 4. Ammonia produces at first a greenish-blue precipitate, which then dissolves in excess of ammonia, forming a deep blue solution. 5. Potassium ferrocyanide gives a reddish-brown precipitate. 6. If a clean piece of iron or steel is immersed in an acid solution of a copper salt it becomes coated with metallic copper. 7. Copper salts colour the flame green. With borax they give a bead which is green in the oxidising flame, but becomes blue on cooling; when a little tin oxide is added and the whole placed in the reducing flame, the bead becomes reddish-brown.

Estim., &c. 1. A slight excess of caustic soda is added to the boiling solution of the copper salt, and the resulting precipitate is carefully washed, dried, ignited, and weighed. It is the oxide of copper (CuO); its weight multiplied by 0·798 gives the corresponding weight of metallic copper. 2. The solution, which must be free from nitric acid, is placed in a weighed platinum dish, and a piece of pure zinc is thrown in, and some hydrochloric acid added if necessary. Hydrogen is evolved, and metallic copper deposited. When the zinc has dissolved, and all the copper has been precipitated (in which case a small sample of the liquid gives no black precipitate with sulphuretted hydrogen), the deposited copper is washed repeatedly by decantation, dried, and weighed in the platinum dish.

Copper can be separated from the other metals by means of the following processes:

From lead. By adding sulphuric acid to the nitric acid solution, evaporating to dryness, and digesting the residue with water; copper sulphate dissolves out, and lead sulphate is left behind. From this solution the oxide of the copper may be thrown down as before.

From tin. By digestion with hot nitric acid, which dissolves out the copper.

From zinc. By sulphuretted hydrogen which throws down the sulphide of copper from an acid solution.

From silver. By dissolving in nitric acid, and precipitating the silver as chloride by means of hydrochloric acid.

Copper may be separated, in a state of great purity, from antimony, arsenic, bismuth, lead, iron, tin, zinc, &c., as it exists in bell-metal, brass, bronze, gun-metal, mosaic gold, and other commercial alloys, by fusing it in a crucible for about half an hour, along with copper scales (black oxide) and ground bottle-glass, or other like flux. The pure metal is found at the bottom of the crucible, whilst the impurities are either volatilised or dissolved in the flux. The proportions for refining commercial copper are, metal, 10 parts; copper scales and bottle-glass, of

each, 1 part. The Society of Arts conceived this process to be so valuable that they presented one of their gold medals to its inventor, Mr Lewis Thompson.

Uses, &c. The ordinary uses of copper are well known. In *medicine,* 3 or 4 gr. of the filings or powder were formerly given in rheumatism, and to prevent hydrophobia. Some of its salts are still used as astringents, emetics, and caustics. Its alloys are of great value. With zinc it forms BRASS; with tin, BRONZE, BELL-METAL, GUN-METAL, and SPECULUM-METAL. WHITE COPPER is formed by the addition of metallic arsenic, and GERMAN SILVER is a mixture of nickel, zinc, and copper.

Ant. Copper in the metallic state is almost inert, but all its compounds are poisonous. The antidotes are—the white of egg, milk, or flour, mixed with water. The hydrated sulphides of iron, iron filings, and ferrocyanide of potassium have also been strongly recommended, and are exhibited in the same way. Sugar is likewise highly spoken of as an antidote. In all cases a strong emetic should be first given.

Obs. Culinary and pharmaceutical vessels are very commonly made of copper, but too much caution cannot be exercised in their employment. Acid syrups, vegetable juices, aqueous extracts, soups, stews, &c., prepared in copper saucepans or boilers receive a metallic contamination proportional to the length of time they are exposed to the action of the metal. Such vessels are frequently tinned, for the purpose of protecting the copper from contact with their contents, but this film of tin is necessarily very thin, and soon becomes imperfect by constant use. When copper vessels are allowed to remain wet or dirty, or, more especially, greasy, a poisonous green rust forms upon the surface, somewhat similar to verdigris. If articles are prepared in them in this state serious consequences may ensue. Cases of poisoning from this cause are frequently met with, and instances of vomiting following the use of such articles are almost of daily occurrence, without the reason being suspected. We have occasionally seen confections and extracts, prepared in copper pans, deposit a coating of that metal upon the knives used to stir them. The ashes of the inspissated juices of fresh vegetables, and especially the pulps of fruit, prepared in vessels of this metal, have exhibited the presence of copper on the application of chemical tests. Ketchup is frequently rendered poisonous in this way. The most wholesome material for culinary utensils is thin sheet iron or tinned iron plate (TIN), which is very durable if kept clean and dry if not in use. Copper vessels of every kind should be cleaned out immediately before use, even though they may not appear to require it, and on no account should they be employed for any fluids that are the least acidulous, or that may have to remain long in them.

The following enamel is recommended in Dingler's Polytechnic Journal for coating the inside of the copper vessels, used for cooking fruit or vegetables:—12 parts of white fluor-spar, 12 parts of unburnt gypsum, and 1 part of borax, are finely powdered, intimately mixed, and fused in a crucible. The fused mass is then poured out, and after cooling is rubbed up to a paste. The copper vessel is then coated inside with this preparation, which is applied by means of a brush, and the vessel is placed in a moderately warm place, so that the coating may dry uniformly, after which it is subjected to a gradually-increasing heat, till at length the preparation fuses. On cooling, the vessel is found to be protected internally by a white opaque enamel, adhering very firmly to the copper, not chipping off by ordinary knocking and rubbing, and impervious to vegetable acids.

Copper may be cleaned by applying a small portion of the following paste, and rubbing it dry by a flannel or leather:—1 oz. oxalic acid, 6 oz. rotten stone, ½ oz. gum-arabic, all in powder; 1 oz. of sweet oil, and sufficient water to make a paste.

Copper, Neutral Acetate of. $Cu(C_2H_3O_2)_2$. *Syn.* NOR′MAL CUPRIC ACETATE, ACETATE OF COPPER, CRYS′TALLISED VERDIGRIS. *Prep.* Dissolve common verdigris or cupric hydrate in hot acetic acid, so as to form a highly concentrated solution; filter the solution and put it in a cool place to crystallise.

Prop. Beautiful dark, bluish-green prisms, which dissolve in 14 parts of cold and 5 parts of boiling water.

Copper, Ba′sic Acetates of. *Syn.* SUB-AC′ETATES OF COPPER. Common verdigris is a mixture of several basic acetates which have a green or blue colour. One of these (SESQUIBASIC ACETATE) is obtained by digesting powdered verdigris in tepid water, filtering, and allowing the filtered solution to evaporate spontaneously. It may also be obtained in a state of purity by adding liquor of ammonia in small portions to a boiling concentrated solution of the neutral acetate till the precipitate is just redissolved, and leaving the solution to cool. It forms a blue, crystalline mass, but little soluble in cold water. The green, insoluble residue of the verdigris, after treatment with tepid water, contains another acetate (TRIBASIC ACETATE); this may be formed by digesting neutral acetate of copper with the hydrated oxide. A third salt (DIBASIC ACETATE, BLUE VERDIGRIS) is prepared on a large scale in France by exposing copper to the air in contact with fermenting wine-lees.

Copper, Ammo″nio-sul′phate of. *Syn.* SULPHATE OF CUPRAMMONIUM, CU′PRO-SULPHATE OF AMMO″NIA; CUPRI AMMO″NIO-SULPHAS, L.; CUIVRE AMMONIACAL, Fr.; KUPFER SALMIAK, Ger. *Prep.* Sulphate of copper, 1 oz.; sesquicarbonate of ammonium, 1½ oz.; rub together until carbonate acid ceases to be evolved, then wrap it in bibulous paper, and dry it in the air.

Pur. Pulverulent; dark blue; at an intense heat it is changed into oxide of copper, at first carbonic acid and ammonia, and, afterwards, sulphate of ammonia, being thrown off. It is soluble in water to a splendid purple-blue solution, from which the salt is precipitated by alcohol in blue crystals. This solution has the peculiar property of dissolving CELLULOSE (cotton, paper, &c.). The cellulose may be precipitated from the solution in colourless flakes by the addition of acids.

Uses, &c. It is occasionally employed in *pyro-*

techny. In *medicine,* it has been given in chorea, epilepsy, hysteria, &c., but is now principally used as an injection, as a wash for foul ulcers; used as a collyrium, in opacity of the cornea.—*Dose,* ¼ gr., gradually increased to 5 gr., twice a day. Great care must be taken in drying, as it is apt not only to lose a large portion of its weight, but to become of an inferior colour. Both the ingredients should be separately reduced to powder before mixing them.

Copper, Arsenite of. $(Cu(AsO_2)_2$. See GREEN PIGMENTS (*Scheele's* Green).

Copper, Carbonate of. $CuCO_3 + Cu(OH)_2 + H_2O$. *Syn.* CUPRI CARBONAS, L. *Prep.* Add carbonate of soda in excess to a solution of sulphate of copper, and warm the mixture till the pale-blue, flocculent precipitate becomes sandy and assumes a green tint. Used as a pigment. See GREEN PIGMENTS and VERDITER.

Obs. This is a basic carbonate, the normal carbonate of copper being unknown. Other naturally occurring basic carbonates are MALACHITE and AZURITE. See *Sources* above.

Cuprous Chloride. CuCl. *Syn.* SUBCHLORIDE OF COPPER. *Prep.* By heating the neutral chloride of copper.

Prop. White; fusible; slightly soluble in water; and decomposed by exposure to the air.

Copper, Chloride of. $CuCl_2$. *Syn.* NEUTRAL CHLORIDE OF COPPER. *Prep.* By dissolving copper scales or black oxide of copper in hydrochloric acid, filtering and evaporating the solution, and allowing it to crystallise.

Prop., &c. Green, acicular crystals; deliquescent; soluble in alcohol, the flame of which it colours green. When gently heated it loses water, and assumes the form of a yellowish-brown powder (ANHYDROUS CUPRIC CHLORIDE, or CHLORIDE OF COPPER); at a high temperature it loses half its chlorine, and becomes converted into cuprous chloride.

Cupric Iodide. CuI_2. *Syn.* IODIDE OF COPPER; CU'PRI IODI'DUM, L. *Prep.* By adding iodide of potassium to a solution of sulphate of copper, and washing out with alcohol the free iodine from the precipitate formed. A greenish-white precipitate.

(Commercial.) To a solution of sulphate of copper, 1 part, and protosulphate of iron, 3 parts, add a solution of iodide of potassium, and wash and dry the precipitate. This is the preparation commonly known in the trade by the name of 'iodide of copper.'

Copper, Cyanide of. $Cu(CN)_2$. *Prep.* By adding a solution of potassium ferrocyanide to a solution of a copper salt; the precipitate is collected and dried; it is of a brown colour. An alkaline solution of copper cyanide in potassium cyanide is used in electro-coppering.

Cupric Nitrate. $Cu(NO_3)_2$. *Syn.* NITRATE OF COPPER; CU'PRI NI'TRAS, L. *Prep.* By dissolving black oxide of copper, or the metal itself, in dilute nitric acid, filtering and evaporating the solution, and allowing it to crystallise.

Prop., Uses, &c. Deep-blue prismatic crystals, very soluble in water and deliquescent, soluble in alcohol. Generally used in medicine externally, in injections, or as a caustic, but sometimes given internally, dissolved in mucilaginous liquid. *Dose,* ⅛ to ¼ gr.

Cuprous Oxide. Cu_2O. *Syn.* RED OXIDE OF COPPER, SUBOXIDE; CUPRI SUBOX'YDUM, L. Add grape-sugar to a solution of sulphate or acetate of copper, then further add caustic potassa in excess; the blue solution heated to ebullition deposits the suboxide, which must then be collected, washed, and dried.

A solution of 27 parts cane sugar, in 60 parts water, is poured over 9 parts hydrated oxide of copper (weighed in the compressed and still moist state); a solution of 18 parts caustic potassa, in 60 parts water, is then added, and the whole mass well agitated together at the ordinary temperature, and strained through linen. If the dark-blue filtrate is next heated (continually stirring) over a water-bath, anhydrous cuprous oxide is precipitated, and the liquor becomes nearly colourless.

Prop., Uses, &c. A superb red powder, with a metallic lustre. It often occurs in beautiful transparent, ruby-red crystals, associated with other ores of copper, and can be obtained in this state by artificial means. It is used as a pigment and a bronze, and as a stain for glass and enamels, to which it gives a rich red colour. When heated in air it is converted into the black oxide. With ammonia it forms a colourless solution, which rapidly becomes blue when exposed to the air.

Cupric Oxide. CuO. *Syn.* OX'IDE OF COPPER, BLACK OXIDE, PROTOXIDE, CUPRI PROTOX'YDUM. *Prep.* 1. By heating the nitrate or carbonate of copper to redness. When it ceases to lose weight the conversion is completed, and the oxide appears as a heavy, black powder.

2. By heating in the air the hydrated oxide thrown down from solutions of copper by pure potassa.

3. By adding caustic potassa, in excess, to a solution of a cupric salt, and heating the whole to boiling; the precipitate is then collected, washed, and dried. A heavy, black powder.

Uses, &c. Protoxide of copper is unchanged by heat unless combustible matter is present, when it readily parts with its oxygen; hence its general use in ORGANIC ANALYSIS as a means of oxidising organic substances at a high temperature. It communicates a beautiful green colour to glass and enamels. With the acids it produces the ordinary salts of copper.

Cupric Sulphate. $CuSO_4.5H_2O$. *Syn.* SULPHATE OF COPPER, BLUE COP'PERAS, B. VIT'RIOL; CU'PRI SUL'PHAS, L.; SULFATE DE CUIVRE, F.; KUPFER VITRIOL, Ger. *Prep.* (Commercial.) The sulphate of copper of commerce is obtained by roasting native sulphide of copper (COPPER PYRITES); copper sulphate and iron sulphide are thus formed. The mass is then extracted with water, which dissolves the copper sulphate; or it is heated with dilute sulphuric acid ('chamber acid'), in which the copper dissolves, while the iron sulphide remains behind. In either case the copper sulphate is obtained by evaporating the solution and allowing it to crystallise. The water found in and issuing from copper mines often furnishes such a solution ready to the hands of the manufacturers. A large quantity of sulphate of copper is also obtained as a secondary product in the refining of silver.

(Pure.) By the direct solution of the metal, or, preferably, of its oxide or carbonate in sulphuric acid, or by purifying the commercial salt by re-crystallisation, &c.

Prop., Uses, &c. Fine blue crystals, slightly efflorescent, having an intensely styptic and metallic taste. By heat the blue salt loses its water of crystallisation, and becomes a white, anhydrous powder. It dissolves in 4 parts of water at 60° F., and in 2 parts at 212°; is insoluble in alcohol and ether; and is decomposed at an intense heat into protoxide of copper, sulphurous acid, and oxygen. It has been used to prevent the dry rot in timber, and in dyeing. It is largely employed in ELECTROTYPING. Grain is steeped in a weak solution of it by the farmer, to prevent the 'smut.' As a medicine it is employed chiefly as a styptic (in solution), and caustic (in substance) to destroy 'proud flesh'; and, less frequently as an astringent or tonic (from $\frac{1}{4}$ gr. to 2 gr.), and an emetic (3 or 4 gr. to 10 or 12 gr.) It is exceedingly poisonous.

COP'PERAS. This is a generic name for the CRUDE METALLIC SULPHATES. When used without a qualifying adjective, it generally means sulphate of iron.

Copperas, Blue. Crude sulphate of copper. See COPPER (*above*).

Copperas, Calcined. From green copperas, heated in an unglazed earthen pot until it becomes white and dry. Used as an astringent and 'drier,' and in making ink and dyeing.

Copperas, Green. *Syn.* COPPERAS. Crude sulphate of iron. See IRON.

Copperas, White. Crude sulphate of zinc. See ZINC.

COP'PERING. Iron may be covered with a thin film of copper by merely immersing it (previously scoured clean) in an acidulated solution of sulphate of copper, after which it must be rinsed in clean water. This film soon rubs off, but still it lasts long enough to deceive the travelling tinker's customers, who imagine that their copper kettles are properly repaired. Metals may be conveniently coated with compact copper to any desired thickness by means of voltaic electricity. See ELECTROTYPE.

COP'ROLITE. *Syn.* DUNG'STONE, FOSSIL MANURE. This mineral is the petrified dung of carnivorous reptiles (*Buckland*). Coprolites are found in all the secondary and tertiary strata, especially in the Greensand formation. They concontain a considerable proportion of phosphate of lime, for which reason they are largely employed in the manufacture of artificial manures. They form the bases of Lawes' SUPERPHOSPHATE OF COPROLITE MANURE. The nodules, after being washed, are ground to powder in a mill, and mixed with an equal weight of oil of vitriol.

COPTIS TEETA. (Ind. Ph.) *Syn.* COPTIS, or MISHMI TITA. *Hab.* Mishmel mountains, east of Assam. *Officinal Part.* The dried root (*Coptidis radix*), imported into Bengal from Assam in small rattan baskets, each containing from 1 to 2 oz. of the drug. This consists of pieces of a woody rhizome, of the thickness of a small goose-quill, and from 1 to 2 inches in length, often contracted at one extremity into a short woody stem; the surface is usually rough, irregular, more or less annulated, and marked with the remains of rootlets, in the shape of short spiny points. Externally, yellowish-brown; internally much brighter, frequently of a golden-yellow colour, exhibiting on fracture a radiated structure. Taste, persistently bitter, and when chewed tinges the saliva yellow. Contains neither tannic nor gallic acid, but abounds with a yellow, bitter principle, which is the alkaloid *Berberine.*—*Prop.* Pure bitter tonic.—*Therapeutic Uses.* In debility, convalescence after fevers, and other debilitating diseases, atonic dyspepsia, and in mild forms of intermittent fevers.—*Dose,* 10 to 15 gr. of the powdered root, thrice daily.

Tincture of Coptis (Tinctura Coptidis). Take of coptis root, in coarse powder, $2\frac{1}{2}$ oz.; proof spirits, 2 pints. Macerate for 7 days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient proof spirit to make 1 pint.—*Dose,* $\frac{1}{2}$ to 2 fl. oz.

Infusion of Coptis (Infusion Coptidis). Take of coptis root, in coarse powder, 5 dr.; boiling water, 1 pint. Infuse in a covered vessel for 2 hours, and strain.—*Dose,* 1 to 2 fl. oz. thrice daily.

COR'AL. *Syn.* CORAL'LIUM, L. The comprehensive term for all calcareous or stony structures secreted by the marine asteroid polypes, or zoophytes. The RED CORAL of commerce which is so largely employed for beads, ear-rings, and other ornaments, may be described as the internal skeleton of *Corallium rubrum.*

Coral, Red (Facti''tious). *Syn.* CORAL'LIUM RU'BRUM FACTI''TIUM, L. Prepared chalk coloured with a little sesquioxide of iron or rose pink, and passed through a sieve. Sold by the druggists for powdered coral.

Coral, Prepared Red. *Syn.* CORAL'LIUM RU'BRUM PREPARA'TUM, L. Levigated coral was formerly used in medicine as an antacid or absorbent, and is still occasionally employed as a dentifrice. It consists almost entirely of carbonate of lime, coloured with red oxide of iron, and possesses no advantage over good chalk. It is prepared in a similar manner as chalk.

Coral, to Bleach. Immerse the coral in a mixture composed of 1 part of hydrochloric acid, and 30 parts of water; and keep it in this liquid until it becomes quite white. It should then be taken out, washed well in cold water, and allowed to dry.

CORALLINE. See TAR COLOURS.

CORDIALS. *Syn.* CARDIACA, L. Warm, stimulating, restorative medicines, that tend to raise the spirits and promote the circulation. The principal cordial medicines are noticed under the heads TINCTURE and SYRUP. See also PATENT MEDICINES.

Cordials. Aromatised and sweetened spirits used as beverages. See LIQUEUR.

CORIAN'DER. *Syn.* (CORIANDER FRUIT, CORIANDRI FRUCTUS, B. P.); CORIANDERS, C. SEED; CORIANDRUM (Ph. L. E. & D.), L. "The ripe fruit of the *Coriandrum sativum,* dried" (B. P.). Coriander is chiefly used by confectioners and distillers as a flavouring ingredient. In the East it is much employed as a condiment, being an ingredient in CURRY POWDER. It is aromatic,

carminative, and stimulant; and more effectually covers the taste of senna than any other substance. —*Dose,* 20 to 60 gr.; chiefly used as a corrective or adjuvant in compound medicines.

CORK. The outer bark of the *Quercus suber,* or *cork oak,* a tree common in southern France, Italy, and Spain. The bark obtained from the younger branches of the same tree is employed for tanning. See ALCORNOCO.

Cork. A stopple or plug for a bottle or jar cut from the above substance. The common practice of employing inferior corks for the purpose of stopping the mouths of bottles is often productive of considerable loss from the air being only partially excluded, and the contents suffering in consequence. Many a large bin of valuable wine has become, from this cause, in less than a year, little better than sour 'Cape.' Chemical preparations often suffer from a similar cause. The best corks are those called 'velvet corks,' and of these the finest qualities are imported from France. No pains should be spared to obtain sound and soft cork for connecting the combustion- and drying-tubes used in organic analysis.

Ruschhaupt gives the following process for preparing corks for corking bottles containing alcoholic or caustic liquids:—Paraffin is fused in a suitable vessel, the dry corks are added, and immersed in the paraffin by means of a perforated spoon or disk. The air is now easily expelled from the pores of the corks, which after about five minutes are removed and cooled; they may now be cut and bored like wax, are easily driven into the necks of bottles and readily removed, retain their smoothness, and are gas-tight throughout.

Several attempts have been made to introduce cork-cutting by machinery, but they have hitherto failed to supersede hand labour.

Cork-bo″rer. A thin brass tube, filed to a cutting edge, used for piercing holes through corks. Several tubes of different sizes, which fit into each other, are generally sold together. This simple and convenient instrument was introduced into the laboratory by Dr Mohr.

CORN. *Syn.* CLA′VUS, L. A horny induration of the skin, with a central nucleus, very sensitive at the base. The common cause of corns is continued pressure over the projection of the bones, from tight or stiff boots or shoes. They are of two kinds, hard and soft. The first grow on the exposed portions of the joints; the last, between the toes.

Preven. This consists in keeping the feet clean by frequent ablution with warm water, and in the use of easy, soft boots and shoes. Without the latter precaution corns will generally return, even after they appear to have been perfectly removed.

Treatm. After soaking the feet in warm water for a few minutes, pare the corns as close as possible with a sharp knife, taking care not to make them bleed. They may now be touched over with a little lunar caustic or nitric acid, or a little concentrated acetic acid or aromatic vinegar. The last two do not stain the skin. The first is used by merely rubbing it on the corns, previously slightly moistened with water; the others, by moistening the corns with them by means of a small strip of wood, or, preferably, a rod of glass; due care being taken not to allow the liquid to to touch the neighbouring parts. This treatment, adopted every 3 or 4 days for 10 days or a fortnight, accompanied by the use of soft, loose shoes, will generally effect a cure. It has been recommended to remove large corns by ligatures of silk, applied as close to their base as possible, and tightened daily until they drop off; but this plan is tedious and often inconvenient, and is not always successful. Another mode of extirpation is the application of a small blister, which will frequently raise them with the skin out of their beds. In this case the exposed surface must be dressed with a little simple ointment. Soft corns may be removed by applying ivy leaf previously soaked in strong vinegar, changing the piece every morning; or by placing a dressing of soap cerate, spread on a bit of lint or old rag, between the toes. One of the simplest and best remedies for hard corns, and which has received the sanction of high medical authority, is to wear upon the toe or part affected a small, circular piece of soft leather, or, still better, a piece of amadou, spread with diachylon, or some other emollient plaster, and having a hole cut in the centre, corresponding to the size of the corn (*Sir B. Brodie*). By this means the pressure of the boot or shoe is equalised and the apex of the corn protected from injury. The following are among the most useful of the POPULAR REMEDIES FOR CORNS:

Corns, Caus′tic for. *Prep.* From tincture of iodine and chloride of antimony, of each, 1 dr.; iodide of iron, 3 gr.; mix. It is applied with a camel-hair brush after paring the corn. 2 to 4 applications are said to effect a cure.

Obs. Most of the remedies noticed below really act as caustics.

Corns, Lotion for. *Prep.* 1. A solution of sal-ammoniac, 1 part; in proof spirit, 4 parts.

2. A concentrated aqueous solution of sulphate of copper. To be applied night and morning.

Corn Plasters. *Prep.* 1. From white diachylon, 3 parts; yellow resin, 2 parts; verdigris, 1 part; melted together and spread on leather.

2. From galbanum plaster, 1 oz.; verdigris, 1 dr.; as the last.

3. From resin plaster, 2 oz.; black pitch, 1 oz.; verdigris and sal-ammoniac, of each, ½ dr.

4. To the last add powdered opium, 1 dr. Recommended to allay pain, &c.

5. (*W. Cooley.*) A piece of spread adhesive plaster is placed upon a table, and a piece of card paper having a round hole cut in it the size of the central portion of the corn is laid upon it; the exposed part is then softened by holding a piece of heated iron for a second or two near it; the card paper is then instantly removed, and nitrate of silver in fine powder is sprinkled over the part which has been warmed. As soon as the whole is cold, the loose powder is shaken off, and the plaster is ready for use. Very cleanly and convenient. Two or three applications seldom fail to effect a cure.

6. (MECHANICAL CORN PLASTERS.) From common adhesive plaster spread on buckskin, amadou, or vulcanised india rubber cut into pieces, and a circular hole corresponding to the size of the corn punched in each.

Corn Sol′vent. *Prep.* 1. Carbonate of po-

tassa or pearlash, contained in an open jar or bottle set in a damp place, until it deliquesces into an oil-like liquid (oil of tartar). Applied by means of a feather, or a small piece of rag dipped in it is bound on the corn.

2. Hydrate of potassa, 1 dr.; rectified spirit, 1 oz.; dissolve. As No. 1.

3. Carbonate of potassa, with smalts, ochre, or bole, q. s. to give it the required colour. It must be kept dry in a well-corked bottle. A pinch is placed on the corn, and confined by means of adhesive plaster or rag.

4. Carbonate of soda, 1 oz., finely powdered and mixed with lard, ½ oz. Applied on linen rag every night.

5. (*Sir H. Davy's.*) Carbonate of potassa, 2 parts; salt of sorrel, 1 part; each in fine powder; mix, and place a small quantity on the corn for 4 or 5 successive nights, binding it on with a rag.

Obs. Care must be taken, in all cases, to pare the corn moderately close before applying the remedy; but in *no case should any of the above be applied to a raw surface.*

Corns, Pomade for. *Prep.* 1. Powdered verdigris, 1 dr.; savine ointment, 7 dr.

2. Dried carbonate of soda, 3 dr.; lard, 5 dr.; verdigris or smalts, q. s. to give a slight tinge of green or blue. Applied on a piece of rag.

Treatm. for Horses. "Pare out carefully the seat of corn, removing all reddened and diseased horn; reduce the crust of the quarter slightly, where it is unduly strong, but leave the bars and frog untouched. They must be religiously preserved, especially in weak feet, to afford a wide bearing for the bar shoe that should afterwards be used. To soften the parts, apply, in bad cases, a poultice for a day or two, and a few drops of nitric acid, when the horn is dry and scurfy; keep the hoof soft with soft soap and lard, or any emollient dressing, and pare out the corn every fortnight. In horses subject to corns, shoe and pare out frequently; and, along with leather pads, use a bar shoe made with a wide heel on the inside quarter, and nailed only on the outside, or with one nail toward the inside toe" (*Finlay Dun*).

CORRO'SIVE SUBLIMATE. See MERCURY.

CORUN'DUM. See EMERY.

CORYZA. Cold in the head. See CATARRH.

COSMET'ICS. *Syn.* COSMET'ICA, L.; COSMETIQUES, Fr. External applications employed for the purpose of preserving or restoring personal beauty. The term is generally understood to refer to substances applied to the cuticle to improve the colour and clearness of the complexion; but some writers have included under this head every topical application used with the like intention. Hence, cosmetics may be divided into—CUTANEOUS COSMETICS, or those applied to the skin; HAIR COSMETICS, or such as are employed to promote the growth and beauty of the hair; and TEETH COSMETICS, or such as are used to cleanse and beautify the teeth. See BALDNESS, COSMETIQUE, DENTIFRICES, DEPILATORY, HAIR-DYE, POMADE, TOOTH POWDER, &c.

COSMETIC VINEGAR (Acetum Cosmeticum), is a mixture of tinct. benz., 60 parts; bals. Peruv., 10 parts; eau de Cologne and bals. vitæ Hoffm. ph. bor. āā 150 parts; aceti puri, 300 parts; allowed to precipitate and filtered clear.

COSMETICUM. (*Dr Henry's.*) For scalp diseases and an application for the hair. Spirit, 180 parts; oil of lemon, 3 parts; oil of bergamot, oil rosemary, oil of lavender, of each, 1 part (*Hager*).

Cosmeticum. (*Siemerling.*) For skin affections, freckles, &c. Sweets almonds, 30 grms.; bitter almonds, 15 grms.; blanched and emulsified with 330 grms. of water; the emulsion strained and mixed with 25 grms. of tinct. benzoin, and 15 grms. lemon juice (*Wittstein*).

COSMETIQUE. [Fr.] Hard pomatum formed into a cake or stick for the toilet. It is sometimes coloured black or brown, the pigments being added in a state of impalpable powder.

1. (BLACK—COSMETIQUE NOIR.) From good lard, 5 parts; wax, 2 parts; (or, hard pomatum, 7 parts;) melt, stir in levigated ivory-black, 2 parts; and pour into moulds of tinfoil; which are afterwards to be placed in paper sheaths.

2. (BROWN—COSMETIQUE BRUN.) As the last, but using levigated umber for 'plain brown,' and levigated terra di Sienna for 'auburn' and 'chestnut.'

3. (WHITE, OR PLAIN—COSMETIQUE BLANC.) The same, without colouring matter.

Obs. They are generally scented with musk, ambergris, or cassia.

Use. The above are used to colour moustaches, eyebrows, whiskers, &c., as well as to keep the hair in its place. The labels on the packets before us have—'pour fixer et lisser les cheveux.' The application must be renewed daily, as the cosmetique is gradually removed by friction, and perfectly so by soap-and-water.

COSMOLINE. See VASELINE.

COSMOS POMADE. (*J. Pohlmann*, Vienna.) 1½ parts white wax, 3 parts spermaceti, 2 parts castor oil, 8 parts almond oil, 2 parts glycerine, 9 parts extract of mignonette, ½ part eau de Cologne (*Hager*).

COSTUS OF THE ANCIENTS, the root of *Saussurea lappa*, Clarke (*Aucklandia costus*, Falc.), a plant of Cashmere, where it is called *Koot*. Large quantities of it are sent to different parts of India, the Persian Gulf, and China. It is used in medicine in India and China, and in Cashmere for protecting bales of shawls from the attacks of insects.

COTARN'INE. A crystallisable substance obtained from the mother-liquors of opianic acid. It is basic, very soluble, and bitter. Hydrochlorate of cotarnine is soluble and crystalline.

COTO BARK. A bark said to be imported from the interior of Bolivia, and thought by Dr Wittstein to belong to a lauraceous or a terebinthinaceous plant. In one specimen examined by Jobst was found a yellowish-white crystalline substance with the biting taste of the bark, which Jobst believes to be its active principle, and to which he gives the name *Cotoin.* Another sample, however, analysed by Jobst in conjunction with Hesse, failed to yield any *cotoin*, but gave instead a crystalline mass which consisted principally of three crystalline bodies, to which these chemists purpose applying the names *paracotoin, oxyleucotin,* and *leucotin.* Dr Gietel reports that he

made trial of the bark therapeutically with some patients in the general hospital of Munich, and the results he obtained were such that he regards it as a specific against diarrhœa in all its varieties. Sometimes he administered it in the form of powder, and at others in that of tincture, the latter being made in the proportions of 1 part of bark to 10 of spirit. He gave the powder ½ gr. 4 to 6 times a day, and of the tincture 10 minims every 2 hours. Herr Burkhart, similarly making trial of the *cotoin* and *paracotoin*, was equally successful as far as regarded its antidiarrhœic action, *paracotoin*, however, exercising a slighter effect than the *cotoin*. Herr Burkhart administered paracotoin either in powder 1-100th of a grm., with 1-5th of a grm. of sugar every 3 hours, ½ grm. rubbed up as an emulsion.

COT'TON. *Syn.* Gossypium, L. The cotton of which textile fabrics are made consists of hairs covering the seeds of certain plants belonging to the Nat. Ord. Malvaceæ, or the Mallow family. Our commercial cotton appears to be derived from four distinct species, viz.:

Gossypium arboreum. The tree cotton, an Indian species. Unlike the other cotton-plants, it has the dimensions of a small tree. The cotton-hairs are remarkably soft and silky, and are woven by the natives into very fine muslin, used for turbans by the privileged classes only.

Gossypium Barbadense. The 'Barbadoes' or 'Bourbon cotton-plant.' This is the species which yields all our best cotton. In the small American islands which fringe the coast from Charlestown to Savannah, this plant has produced the celebrated 'sea-island cotton,' which is unrivalled for the length of its 'staple,' its strength, and silkiness.

Gossypium herbaceum. The common cotton-plant of India. It produces the Surat cotton of commerce.

Gossypium Peruvianum or acuminatum. A species supposed to be indigenous to America. It furnishes the South American varieties of cotton, as Pernambuco, Peruvian, Maranham, and Brazilian.

Identif. See Linen.

Dyeing. The fibres of cotton have nearly the same affinity for mordants and the colouring matter of dyed stuffs as linen, and may be treated in the same manner. See Dyeing, Linen, &c.

Cotton-cake. The cake remaining after the expression of the oil from the seeds of the cotton-plant (*Gossypium*) is used as a cattle food. The decorticated is preferred to the undecorticated variety, as the latter is said to occasionally set up dangerous internal irritation amongst the animals partaking of it.

Composition of cotton-cake (decorticated):

Moisture	9·18
Oil	16·05
Albuminous compounds	41·25
Non-nitrogenous principles	16·45
Phosphates and insoluble earthy matters	8·15
Woody fibre	8·92
	100·00

Cotton, Gun-. See Pyroxylin.

Cottons, Medicated. Besides the pure cotton-wool used in surgery we have now a considerable number of ingenious preparations in which the pure cotton is impregnated with a variety of medicinal substances, in order to render it a valuable agent in the dressing of wounds, in painful swellings or indurations, and for a number of external applications.

Purified Cotton-wool. Macerate the commercial article for the space of 10 minutes in benzol; press out the liquid and allow the cotton-wool to dry by exposure to the air. Another method is to macerate the cotton in a warm weak solution of soda, then to wash well with water; finally wash with very dilute hydrochloric acid and water until neutral, then dry and comb the wool. This treatment has for its object to remove any grease or resinous matters which may be present in the samples, and thereby enables them to absorb the medicating substances more easily. Many greasy samples of cotton-wool will not mix with watery liquids at all, and cotton which is impregnated with oils or resinous substances absorbs the active ingredients irregularly, yielding a preparation which is far from uniform in quality.

Iodised Cotton. The iodised cotton of Méhu is prepared by thoroughly drying 375 gr. of pure cotton-wool in a stove; then mixing with it 30 gr. of iodine, and placing the mixture in a closed flask at a temperature of 212° F. for an hour; this is effected by placing the flask upon a water-bath. The iodine is thus equally diffused throughout the cotton. This preparation, we are assured, acts as a useful revulsive in neuralgia, serous effusions, slight inflammation of the respiratory organs, &c. A modern French work gives the following instructions: Iodine, 1 part; purified cotton-wool, 12 parts. Enclose the iodine in some filter-paper and place it at the bottom of a flask with wide mouth; then introduce the cotton-wool and close the flask by covering the mouth. Place the flask in a moderately warm place until the cotton appears to be uniformly coloured by the iodine. The preparation must be kept in stoppered bottles with wide mouths, placed in a cool place and out of the light.

Salicylated Cotton. This preparation consists of purified cotton-wool impregnated with about 10% and 4% of salicylic acid, and the same quantity of glycerine to make it adhere. It has been found useful as an antiseptic agent in the dressing of wounds. In cases of amputation it is asserted that the patient has been kept without fever by the use of a salicylated cotton-wool dressing, which was only required to be renewed at the end of the week. The formula for its preparation is as follows: Purified cotton-wool, 100 parts; salicylic acid, 10 parts; rectified spirit, 100 parts; glycerine, 10 parts. Dissolve the salicylic acid in the rectified spirit; and the glycerine to the solution; saturate the cotton-wool with the liquid; press out the superfluous liquid; dry with the usual precautions; and keep in wide-mouthed bottles.

Boracic Acid Cotton. To prepare this the ingredients used are taken in these proportions: Purified cotton-wool, q. s.; boracic acid, 10 parts; water, 90 parts. Dissolve the boracic acid in the water at a temperature of 140° F. (60° C.); saturate the purified cotton-wool with this solution;

press it, dry it, and preserve it in corked bottles having a very wide mouth.

IODOFORM COTTON. This preparation has come somewhat extensively into use during the last 5 or 6 years. It is best made in the following manner. It is necessary that each ingredient be taken very accurately according to the proportion given: Iodoform, 1 part; ether, 10 parts; purified cotton-wool, 10 parts. Dissolve the iodoform in the ether, and saturate the cotton-wool with the liquid. Let it dry by exposure to the air. Draw the cotton out and keep it in glass-stoppered bottles with a wide mouth, closing well, and place in a dark, cool place.

GLYCERINATED COTTON. This is a preparation recommended by Gubler. It consists simply of pure cotton-tissue permeated with pure glycerine; and it is said that cotton so prepared is permeable to all medicinal liquids without losing either its suppleness or its lightness. It is obtained by pouring a few drops of pure glycerine upon squares of cotton, and then squeezing them as strongly as possible with the hands.

HÆMOSTATIC COTTON. To prepare hæmostatic cotton the purified cotton-wool is boiled in a solution of soda, and then plunged into a solution of perchloride of iron. It was invented by the German pharmacist, K. Ehrle, and has been extolled on the Continent both for hospital and camp use. It is used like lint.

SAL ALEMBROTH COTTON. Saturate 100 parts purified cotton-wool with 2% sal alembroth dissolved in water tinted with aniline blue.

AMMONIACAL COTTON. This product was described a few years ago by Mr B. Brown, who observed that when ammonia gas is passed through pure, dry cotton-wool, it is absorbed to a very large amount. In a water-bath, exposed to the air, the preparation loses all its ammonia.

COUGH. *Syn.* TUS′SIS, L. The sudden and violent expulsion of air from the lungs. It is generally symptomatic of other affections, but is sometimes idiopathic, or a primary disease. Many cases of cough depend upon the extension of catarrh to the trachea and bronchi, which thus become loaded with mucus or phlegm, which they endeavour to throw off by the convulsive effort called coughing. In some cases it is caused by a vitiation and inspissation of the secretions; this is the common cause of the dry cough of old people. Idiopathic cough is not considered dangerous in itself or while running its regular course, but it is often productive of most serious consequences, by superinducing the inflammation of some organ, or laying the foundation of phthisis.

Cough is sometimes attended by copious expectoration, and at other times exists without any; it has hence been distinguished into moist or mucous cough, and dry cough.

Treatm. This will entirely depend upon the causes and nature of the cough, which may be very various. That of common catarrhal cough consists in allaying the irritation as much as possible, by demulcents and expectorants, as mucilaginous drinks and lozenges, which act upon the glottis, and sympathetically upon the trachea and bronchiæ. Among the first may be mentioned almond milk, barley water, refined Spanish juice, gum-arabic, and a mixture of the last two made into lozenges; among the second, the most innocent and convenient is ipecacuanha, in the shape of lozenges, 2 or 3 of which may be sucked whenever the cough is troublesome. The sucking of ice or the inhalation of a little steam is often sufficient to give relief. Counter-irritants, blisters, and poultices are of great value. A light diet should be adopted, the bowels kept slightly relaxed by the use of gentle aperients, and a mild and equable temperature sought as much as possible. When this plan does not succeed, recourse may be had to an emetic, followed by small doses of Dover's powders, and extract or tincture of henbane or squill pill. When a cough is troublesome at night and unattended with fever, a very small dose of laudanum, or tincture of henbane, taken on going to rest, will generally procure sleep. In the treatment of dry cough the more stimulating expectorants are useful, as garlic, ammoniacum, styrax, and benzoin, combined with narcotics and sedatives, as henbane, hemlock, and opium. A diaphoretic opiate is also very useful, especially in the cough of old people. See DRAUGHT, EMULSION, MIXTURE, PILLS, &c.

COU′MARIN (kōō). *Syn.* CU′MARIN. The odorous principle of the fruit or bean of *Coumaruma odorata* (tonquin bean). It exists in several other plants, as *Melilotus officinalis, Asperula odorata,* and *Anthoxanthum odoratum.*

Prep. From the sliced tonquin beans, by macerating in hot alcohol; straining through cloth, and distilling off the greater part of the spirit. The syrupy residue deposits, on standing, crystals of COUMARIN, which must be purified from oil by pressure, and then crystallised from hot water. It is also made artificially from salicylol or salicylic aldehyde.

Prop. Slender, brilliant, colourless needles; fusible at 122° F., and distilling at a higher temperature without decomposition. It has a fragrant odour and burning taste; it is very slightly soluble in cold water, more freely in hot water, and also in alcohol.

Uses. Ingredient of perfumes and snuffs; 1 part to 50 parts of iodoform disguises the bad smell of the latter.

COUNTER-IR′RITANTS. In *medicine* and *pharmacy,* substances applied to the surface of the body to establish a secondary morbid action, with the view of relieving one already existing. They are classified as rubefacients, epispastics, vesicants, or blistering agents and pustulants. In painful and spasmodic affections, as neuralgia, spasms, and cramp; in rheumatism, lumbago, swelled and painful joints; in headache, sore throat, sprains, languid glandular tumours, and many other cases, this class of medicine often proves extremely valuable. The counter-irritants which are best known are blisters, mustard poultices, hartshorn-and-oil, and liniment of ammonia and iodine.

COURT PLAS′TER. See PLASTER.

COW-DUNG. This substance was formerly employed in large quantities by the calico printers. Recently a mixture of sulphate, carbonate, and phosphate of lime and soda, with British gum or bran, has been successfully tested as a substitute for it, and has the advantage of cleanliness and economy.

COW'HAGE. *Syn.* Cow'itch; Mucun'a (Ph. L. E. & D.), L. "The hairs of the fruit *Mucuna pruriens*" (Ph. L.). "The hairs from the pods" (Ph. E.). "The hairy down" (Ph. D.). It occasions violent itching when it comes in contact with the skin, which can only be allayed by a solution of green vitriol, or by oil. It is frequently administered as a vermifuge, made into a confection, by scraping the hair off a pod into treacle, syrup, or honey for a morning dose, which is repeated for 3 or 4 successive days, followed by a brisk purge. It acts more effectually if its administration has been preceded by a gentle emetic.

Cowhage is, however, but little used at the present day. For commercial purposes the pods are imported chiefly from the West Indies, with the hairs attached. There is besides a considerable demand for cowhage hairs in the Bombay market to export to Europe as is supposed for the preparation of some patent vermifuge.

The pods of several other species of *Mucuna* from the East Indies, Brazil, Africa, &c., are all more or less coated with strong penetrating hairs. The seeds are sometimes drifted across the Atlantic by the Gulf Stream from the West Indian Islands to the Azores, Irish, Scotch, and Norwegian coasts, where they are occasionally picked up. The seeds of *Mucuna capitata*, W. and A., are used in India as a weight (*Massa*) = 8 retti or about 16 gr.

COW-POX. [*Variola vaccina.*] A disease affecting the udder in cows. The treatment consists in fomenting the udder and applying poultices of spent hops, giving laxative and saline medicines, and in drawing off the milk with a teat-syphon.

COWS. See Dairy and Milk.

COW TREE (*Brosimum galactodendron*, Don.). It is a native of the South American forests, particularly in Venezuela, where it grows to a height of 100 feet, and often unbranched for 60 or 70 feet. The milk, which is obtained from incisions in the trunk, closely resembles cow's milk. It is said to be wholesome and nourishing.

CRAB. See Shell-fish.

CRAB OR CARAPA OIL, obtained from the seeds of *Carapa guyanensis*, Aubl., and used by the natives of British Guiana for burning and for anointing their bodies.

CRAB'S EYES, seeds of *Abrus precatorius*, L., q. v.

CRACKNELS. Small, brittle cakes or biscuits, made by first boiling and then baking paste. *Prep.* To flour, 1 pint, add a little grated nutmeg, the yelks of 2 eggs, 2 or 3 spoonfuls of rose-water, and cold water, q. s. to make a paste; then roll in butter, ½ lb., and make it into shapes. In 1 hour put them into a kettle of boiling water, and boil them until they swim, then throw them into cold water; take them out; and when dry, bake them on tins. Those of the shops contain less butter, and the rose-water is omitted.

CRACK'NUTS. Thin and sweet cakes or wafers. *Prep.* 1. Flour, 1 lb.; sugar, ¾ lb.; melted butter, ½ lb.; 6 or 7 eggs, well beaten; make a paste with a glassful of raisin wine and a little water; add caraways, roll it out as thin as paper, cut it into shapes with a tumbler, wash the pieces with the white of egg, and dust them over with powdered sugar.

2. As the last, but using ½ lb. more flour.

CRAMP. See Spasms.

CRANBERRY ORDER (Vacciniaceæ). Shrubs or small trees, natives chiefly of cold and temperate regions. The fruits of some are edible, as the whortleberry or bilberry (*Vaccinium myrtillus*, L.), the cowberry (*V. vitis-idæa*, L.), and the cranberry (*Oxycoccus palustris*, Pers.). Large quantities of cranberries are brought to this country from Canada. They are the fruits of *O. macrocarpus*, Pers.

CRAPE is cleaned by rinsing it in ox-gall and water, to remove the dirt; afterwards in pure water, to remove the gall; and lastly, in a little gum-water, to stiffen and crisp it. It is then clapped between the hands until dry.

CRAY-FISH. See Astacus.

CRAY'ONS. Colouring substances made up into small cylinders or any other convenient form for use in writing or drawing.

Crayons, Draw'ing. *Prep.* 1. Spermaceti, 3 oz.; boiling water, 1 pint; agitate together till they form a species of emulsion; add bone-ash, 1 lb. (or more, previously reduced to an impalpable powder), and colouring matter, q. s. to give the proper tint; reduce the whole to a perfectly homogeneous paste, and form it into crayons.

2. Pipeclay and the finest prepared chalk, equal parts; or pipeclay alone, q. s.; colouring, a sufficient quantity; make them into a paste with pale mild ale.

3. White curd or Castile soap, cut into thin shavings, 1 oz.; boiling water, 1 pint; dissolve, and when cold, add gradually as much rectified spirit of wine as will render the liquid barely transparent. With this fluid make equal parts of the finest elutriated clay and chalk into a stiff paste, adding colouring matter, q. s., as before. For common qualities, the spirit of wine may be omitted, but the mass will then dry more slowly.

4. Curd soap, 1½ oz.; gum arabic, ½ oz.; boiling water, 1¼ pint; dissolve, and use it as the last. General Lomet uses a similar mixture to work up the softest varieties of hematite, with which he thus forms superior red crayon.

5. (Process of the Brothers Joel, of Paris.) Shell-lac, 3 parts; spirit of wine, 4 parts; oil of turpentine, 2 parts; dissolve, add pure clay, 6 parts; colouring matter q. s.; form the mass into crayons, dry them by a stove heat.

6. Pale shell-lac, 5 parts; wood naphtha, 12 parts; dissolve, and with this fluid mix up the colouring powder, previously stirred up with an equal weight of fine pale blue clay; dry by a stove heat as before. When this process is well managed, it produces crayons equal to those of the best Parisian houses.

Obs. The composition may be formed into crayons by simply rolling it on a slab; but to ensure their solidity the manufacturers generally employ a metallic cylinder of 2 or 3 inches in diameter, with one end open and the other firmly secured to a perforated plate, having holes of the same size as the intended crayons. The crayon composition in the state of a stiff paste or dough, is introduced into the open end, and is forced down and through the holes, by means of a small

plug or piston, that exactly fits the inside of the cylinder, and which is driven by the equable motion of a small screw. The pieces that pass through the holes are then cut into lengths and dried.

The substances employed as colouring matters for crayons are very numerous, and their choice offers a wide field for the skill and fancy of the artist. The pigment having been selected, it may be reduced to any shade or tint by admixture with other pigments, and by 'dilution' with a proper quantity of elutriated or prepared chalk. As, however, crayon colours do not admit of being mixed together at the time of using them, like liquid colours, it is usual to make 3 to 6 different shades of each colour, so as to enable the artist at once to produce any effect he chooses.

Crayons, Black. From prepared black-lead, ivory-black, lamp-black, &c. Black chalk and charcoal are frequently made into crayons by simply sawing them into suitably sized pieces. They may then be put into a pipkin of melted wax, and allowed to macerate for an hour, after which they should be taken out, drained, and laid on a piece of blotting-paper to dry. Drawings made with these crayons are very permanent, and if warmed slightly on the wrong side the lines will adhere, and become almost as durable as ink.

Crayons, Blue. From indigo, smalts, Prussian blue, verditer, &c.

Crayons, Brown. From umber (raw and burnt), terra di Sienna (raw and burnt), Cullen's earth, brown ochre, &c.; and some peculiar shades from a mixture of black, carmine, and either of the above colours.

Crayons, Green. From a mixture of king's yellow, or yellow ochre, with blues.

Crayons, Purple. From any of the more brilliant blues, mixed with carmine, lake, or vermilion.

Crayons, Red. From carmine, carminated lakes, vermilion, hematite, and any of the earthy or mineral colours commonly used as pigments. Crayons of red chalk may be prepared in the manner pointed out for crayons of black chalk.

Crayons, White. From pure clay and chalk.

Crayons, Yellow. From king's yellow, Naples yellow, orpiment, yellow ochre, &c.

Crayons, Lithograph'ic. *Prep.* 1. Tallow-soap, 7 parts; white wax, 6 parts; melt by a gentle heat, and add lamp-black, 1 part; keep it melted with constant stirring, for 20 or 30 minutes, then let it cool a little, and cast it into moulds.

2. White wax, 4 parts; shell-lac and hard tallow soap, of each, 2 parts; lamp-black, 1 part; at last.

3. Spermaceti, white wax, and hard tallow-soap, of each, equal parts; lamp-black, q. s. to colour.

Obs. Some makers melt the soap, wax, and lamp-black in an iron ladle, over a brisk fire, and allow the mixture to blaze for a few seconds before adding the shell-lac, which is no sooner thoroughly incorporated than the heat is increased until the mass again kindles, when it is at once removed from the fire and stirred until it is cool enough to be poured into the moulds. This method leads to trouble and loss, without any corresponding advantage. These crayons are used to draw designs upon lithographic stones.

Crayons for Writing on Glass. *Prep.* 1. From French chalk, cut into small pieces. Marks made with these crayons, when obscured or rubbed out, may be several times revived by simply breathing on the glass.

2. (*Brunquelle.*) Spermaceti, 4 parts; tallow, 3 parts; wax, 2 parts; are melted together in a cup; and red lead, 6 parts, and carbonate of potassa (in fine powder), 1 part, stirred in; the mass is kept melted and stirred for about $\frac{1}{2}$ hour longer, then poured into glass moulds (tubes) of the thickness of a common pencil, and cooled as rapidly as possible. The mass may be screwed up and down in the tube, and cut to a point with a knife. A crayon is thus obtained which will readily write upon clean, dry glass.

CREAM. *Syn.* Crem'or, C. lac'tis, Flos lac'tis, L. The oleaginous portion of milk which collects in a thin stratum upon the surface, when that fluid is left undisturbed for some time. By violent agitation, as in the process of churning, the fatty globules unite together, forming butter; whilst the liquid portion, consisting of casein, serum, and a little butter, constituting the residuum, is called buttermilk. This separation is effected the most readily when the cream has become partially sour and coagulated by being kept a few days, a change which occurs in consequence of the conversion of some of the sugar of the serum into lactic acid, which precipitates the caseous matter contained in the small portion of the milk with which the cream is mixed. On these simple facts chiefly depend the successful manufacture of butter. The cream intended for churning should therefore be kept until it turns slightly sour, and assumes the condition above referred to, as then the butter will readily 'come.' If churned while quite sweet the operation will be tedious, and will frequently fail. When this happens the dairy maids declare the milk is 'charmed' or 'bewitched,' and reluctantly proceed with the operation. The addition of a little rennet or vinegar is the proper remedy in this case, and will cause the almost immediate separation of the butter.

When cream is suspended in a linen bag, and allowed to drain, it gradually becomes drier and harder, by the separation of the liquid portion, and then forms what is known by the name of cream-cheese. By the application of slight pressure the separation of the whey is more completely effected, and the product is not only better but will keep longer.

Qual. Cream, from a dietetic point of view, may be regarded in the same light as butter, as it is converted into butter in the process of digestion. On this account much cream should never be taken at once by persons of delicate stomachs. In eating cream with fruit persons are hardly aware of the large quantity they consume, until they find it disagree with the stomach, when the condiment is blamed for the indiscretion of those who take it.

Mr Wanklyn gives the following as the composition of 6 different samples of cream:

	1.	2.	3.	4.	5.	6.
Water . . .	72·20	71·2	66·36	60·17	53·62	50·00
Fat . . .	19·00	14·1	18·87	33·02	38·17	43·90
Milk, Sugar, Casein and Ash . .	8·80	14·7	14·77	6·81	8·21	6·10

A quart of good cream generally yields from 13 oz. to 15 oz. of commercial butter.

Mr Blyth says: "The analysis of cream is conducted on exactly the same principle as that of milk; but the cream must be weighed, not measured; and smaller quantities may be evaporated to dryness in order to estimate the water, if the ratio of water to the solids not fat is such that adulteration may be suspected; for this ratio, although occasionally disturbed by some of the casein rising with the fat, is practically the same as in milk." Mineral adulteration, such as carbonate of magnesia, will be detected, if present, in the ash. See BUTTER, MILK, &c.

Cream, Almond. *Prep.* From sweet almonds, 2 oz.; bitter almonds, 4 in number; blanched and beaten in a mortar to a smooth paste, adding a teaspoonful of water to prevent oiling; and afterwards a pint of cream, and enough powdered lump sugar to sweeten; the whole is then whisked to a froth, the glasses filled with the liquor, and some of the froth placed on the top of each. Some persons add the juice of a lemon.

Cream, Bran'dy. *Prep.* To the last add the yelks of 6 eggs; heat it gently over the fire until it thickens, keeping it well stirred, then further add 2 or 3 glassfuls of brandy, and pour it into small cups or shallow glasses.

Cream, Burnt. *Prep.* Cream, 1 quart; cassia, a small stick; peel of half a lemon; boil for 5 minutes, cool a little, take out the spice, and add the yelks of 9 eggs, and sugar, q. s. to sweeten; stir until cold, put it into a dish, strew pounded sugar over it, and bake it until brown.

Cream, Choc'olate. *Prep.* Chocolate, scraped fine, 1 oz.; thick cream, 1 quart; sugar (best), 6 oz.; heat it nearly to boiling, then remove it from the fire, and mix it well; when cold, add the whites of 8 or 10 eggs; whisk rapidly, and take up the froth on a sieve; serve the cream in glasses, and pile up the froth on the top of them.

Cream, Cof'fee. *Prep.* 1. As the last, omitting the chocolate, and using a pint of the strongest made coffee.

2. Add a teacupful of very clear, concentrated, made coffee to 1 pint each of clarified calf's-feet jelly and good cream; sweeten with lump sugar, give it one boil up, and pour it into shapes or glasses when nearly cold.

Cream, Cold. See COSMETIC, CERATE, and GRANULATED CREAM (*below*).

Cream, Costorph'in. After a village near Edinburgh, where it is commonly made. *Prep.* The milk of 3 or 4 consecutive days, together with the cream, are allowed to remain until sour and coagulated; the whey is then drawn off, and fresh cream added. It is eaten with sugar and fruit, especially with strawberries and raspberries.

Cream, Dev'onshire. *Prep.* 1. (DEVONSHIRE RAW CREAM.) From sour cream mixed with an equal quantity of fresh cream, and sweetened with sugar. Eaten with fruit.

2. (DEVONSHIRE SCALDED CREAM, D. CLOUTED C.) The milk of yesterday is set in a polished, shallow brass pan, over a clear fire free from smoke, and gradually heated until very hot, care being taken not to let it boil; when the undulations on the surface look thick, and form a ring round the top of the fluid, the size of the bottom of the pan, it is removed from the fire and allowed to cool; the next day it is skimmed off for sale. Used with either tea or coffee, and excellent with both; it is also eaten with sugar and fruit, and is made into butter. See CREAM (*above*).

Cream, D'Illotte's. *Syn.* CRYSTALLISED CREAM, VEGETABLE C. The ingenious manufacturer whose anagrammatic powers have converted his patronym of Elliott into one less familiar to vulgar English ears, prepares this really elegant hair cosmetic as follows: Oil of almonds, 3 oz., and spermaceti, ½ oz., are melted together; and bergamot, neroli, and verbena, of each, 5 drops, and huile au jasmin, 10 drops, are then stirred in, and the mixture is at once poured into small, wide-mouthed bottles, to crystallise. If preferred harder, ½ dr. more spermaceti may be used, but the precise quantity to produce the best crystalline appearance depends greatly on the season of the year, more being required in winter than in summer.

Cream, Facti''tious. *Syn.* MOCK CREAM. *Prep.* 1. Beat 3 eggs, with 2 oz. of sugar, and a small piece of butter, until the combination is complete; then add, warm milk, 1 pint; put the vessel into another containing hot water, and stir it one way until it acquires the consistence of cream.

2. Arrowroot, 1 spoonful; wet it with a little cold milk, then add, gradually, boiling milk, ¼ pint; mix well, and further add, of fresh butter, 1 oz.; sugar, 1½ oz.; cold milk, ¾ pint; and continue stirring until the whole is quite cold.

Cream, Fruit. *Prep.* From pulped or preserved fruit, 1 lb.; cream, or good raw milk, 1 quart; sugar, q. s.; boil for 1 minute; cool, and add a glassful of brandy. A froth is raised on these creams with a chocolate mill. It is taken off and placed on a hair sieve, and some of it, after the glasses are filled with the cream, placed on the top of each. The expressed juice of raspberries, of currants, and several other kinds of fruit, also make delicious creams. In winter, raspberry jelly, jam, or syrup may be used. A glass of good brandy improves these creams.

Cream, Fur'niture. See POLISH.

Cream, Gran'ulated. *Syn.* GRANULATED COLD CREAM. *Prep.* (*Owen.*) Almond oil, 6 oz., white wax and spermaceti, of each, 2 oz., are melted together, and a little otto of roses added; the liquor is then poured into a large Wedgewood-ware or marble mortar, previously warmed, and containing 1½ to 2 pints of warm water; brisk agitation with the pestle is then had recourse to, until the oleaginous portion is well divided, when the whole is suddenly thrown into a vessel containing a gallon or two of clean cold water; lastly, the granulated cream is thrown on a muslin filter; and as much water as possible is shaken (gently) out of it; after which it is put up for use.

Cream, Ice. See ICE.

Cream, Lem'on. *Prep.* From cream, 1 pint; yelks of 3 eggs; powdered sugar, 6 oz.; the yellow rind of 1 lemon (grated), with the juice; mix, ap-

ply a gentle heat, and stir until cold. If desired white, the whites of the eggs should be used instead of the yelks.

Cream, Or'ange. Similar to lemon cream, but using oranges.

Cream, Pista'chio. From the kernels of pistachio nuts, as almond cream.

Cream, Rasp'berry. See CREAM, FRUIT.

Cream, Sat'urnine. *Syn.* CREM'OR PLUM'BI ACETA'TIS, L. *Prep.* (*Dr Kirkland.*) Cream, 1 oz.; solution of diacetate of lead, 1 dr.; mix. Cooling, sedative, and astringent; a useful application in certain cases to irritable ulcers, sore nipples, &c. It is poisonous.

Cream, Scotch Sour. *Prep.* (*Gray.*) Skimmed milk is put overnight into a wooden tub, with a spigot at the bottom, and this tub is put into another filled with hot water; in the morning the small tub is taken out and the thin part of the milk ('wigg') drawn off until the thick, sour cream begins to come. This process requires practice as to the heat of the water; when it succeeds, skimmed milk yields nearly one half of this cream, which is eaten with sugar as a delicacy; it is only distinguishable from cream by its taste, and sells for double the price of fresh milk.

Cream, Stone. *Syn.* CREAM BLANCMANGE. *Prep.* From isinglass, ½ oz., dissolved in boiling water, a teacupful, adding cream, 1 pint, and sugar, 4 oz.; stirred until nearly cold, and then poured over fruit or preserves, placed on the bottom of glass dishes.

Cream, Tarax'acum. *Syn.* CREM'OR TARAX'ACI, L. *Prep.* (*Dr Collier.*) From washed dandelion roots (sliced), sprinkled with spirit of juniper, and then pressed for their juice.—*Dose.* A tablespoonful twice or thrice daily, as a stomachic and tonic, in dyspepsia, &c.

Cream, Vanil'la. *Prep.* 1. Boil a stick of vanilla (grated), and isinglass, ½ oz., in milk, 1 pint, until the latter is dissolved; strain, add sugar, 6 oz., and cream, 1 pint; stir till nearly cold, then pour it into moulds like blancmange.

2. Cream and strong isinglass jelly, of each, 1 pint; sugar, 6 oz.; essence of vanilla, ¼ oz.; mix as before.

Cream, Vel'vet. *Prep.* As the last, but, instead of vanilla, flavour with the rind and juice of a lemon, and about a teacupful of white wine.

Cream, Whipped. *Prep.* From the whites of 12 eggs; cream, 1 quart; pale sherry, ½ pint; essence of musk and ambergris, of each, 10 drops; essences of lemon and orange peel, of each, 3 or 4 drops; whisk to a froth, remove the latter on to a sieve, fill the glasses with the cream, and then pile the froth on the top of them.

CREA'SOTE. See KREASOTE.

CREA'TINE. See KREATINE.

CREAT'ININE. See KREATININE.

CRÊME. [Fr.] *Syn.* CREAM. This name is applied to several compound spirits and cordial liquors, especially by the French liqueuristes, who pride themselves on the superior quality and cream-like smoothness of their manufactures. Like the cordials of the English, they are mostly dilute spirit, aromatised, and sweetened. See LIQUEURS.

CRÊME DE BEAUTÉ. A cosmetic consisting of an emulsion of bitter and sweet almonds.

CREN'IC ACID. A brown substance discovered by Berzelius in certain mineral waters. It is a modification of HUMUS, and is produced by the decay of vegetable matter.

CREOLIN. A dark alkaline liquid prepared from coal-tar and caustic soda. With water it forms a whitish emulsion.

Uses. Antiseptic and deodorant. Surgeons agree that it is extremely beneficial wherever the smell of a wound, from whatever cause arising, has to be overcome. In gynæcology it seems to be superior to any solution for irrigating purposes on account of its harmlessness and non-irritating qualities.

In the treatment of leprous ulceration it reduces the fœtor (carbolic acid rather covers it, and that imperfectly), promotes healthy granulations, does not produce poisoning symptoms by absorption, is cheaper than carbolic acid, and does not cause roughness of the dresser's hands. Lotions are made of the strength of 1 in 100 to 1 in 500 of water.

CRESYLIC ALCOHOL. C_7H_8O. A colourless liquid which boils at 203°C. (297° F.). It is found in coal-tar, and also in fir-wood tar; on repeated distillation it yields phenol C_6H_5OH. Nitric acid acts upon it forming nitro-cresylic acids.

CRIB-BITING. The use of deal or any unseasoned wood for the manger may induce this habit in horses. To remedy it the stable-fittings should be of iron. As the habit very frequently arises from acidity of stomach in horses, the administration of chalk or other antacids has been recommended.

CRICK'ETS. These insects may be destroyed by putting Scotch snuff into their holes, or by placing some pieces of beetle wafers for them to eat.

CRINUM ASIATICUM. (Ind. Ph.) *Habitat.* Low humid localities in Bengal, the Concans, and other parts of India; also cultivated in gardens; Ceylon, the Moluccas, and Cochin China—*Officinal part.* The fresh root (*Crini radix*); bulbous, with a terminal, stoloniferous, fusiform portion issuing from the crown of the bulb; emits an unpleasant narcotic odour; readily dried in a stove, and reducible to powder after desiccation.—*Properties.* Emetic; in small doses nauseant and diaphoretic.—*Therapeutic Uses.* Analogous to those of squill.

Juice of Crinum (*Succus crini; Infusum crini*, Beng. Ph.). Take of the fresh root of crinum, ½ oz.; cold water, 2 oz. Bruise the root in a stone mortar, gradually adding the water. Strain, with pressure, through calico.—*Dose.* From 2 to 4 fl. dr. every 20 minutes, until the desired effect is produced.

Syrup of Crinum (*Syrupus crini*). Take of the fresh root of crinum, sliced, 8 oz.; boiling water, 1 pint; refined sugar, 1 lb. Macerate the root in the water for 2 hours, bruise in a mortar, press through calico, add the sugar, and dissolve with the aid of gentle heat.—*Dose.* About 2 fl. dr., repeated as required. Used as a nauseant and emetic for children.

CROPS, INSECTS INJURIOUS TO. See INSECTS.

CRO'TON OIL. *Syn.* OLEUM CROTO'NIS (B. P.),

O. TIGLII (Ph. L. & D.), L. The "oil expressed from the seeds of *Croton tiglium*," or purging croton. This oil is a drastic purgative, and a powerful local irritant and rubefacient. Rubbed on the skin, it produces a pustular eruption, and frequently purges. In this way (diluted with thrice its weight of olive oil) it is occasionally used as a counter-irritant.—*Dose* (as a purge), 1 to 2 drops; in obstinate constipation, lead colic, &c.

The residuum from which the oil has been expressed is sometimes used in veterinary practice under the name of croton cake, or croton farina; but as the amount of oil it contains varies greatly, it is irregular and uncertain in its effects.

CROUP. *Syn.* CYNAN'CHE LARYN"GEA, C. SUFFOCA'TIVA, C. TRACHEA'LIS, L. An inflammatory disease affecting the larynx and trachea.

Symp. A permanently laborious and suffocative breathing, accompanied by wheezing, cough, a peculiar shrillness of the voice, and more or less expectoration of purulent matter, which continually threatens suffocation. There are two varieties, acute croup and chronic croup. The latter is very rare.

Treatm. Bleeding by leeches or cupping, over the region of the trachea, is recommended by some physicians, but the proceeding is heroic, and not usually resorted to. When the symptoms are urgent local irritants, as pieces of lint dipped in strong acetic acid, or blisters, may be applied to the same part. Dr Larroque recommends repeated vomiting in the croup of children; and M. Marotte and M. Boudet have adopted this plan with great success. The treatment consists in making the patient attacked with croup vomit a great number of times within the day, so as to detach the pseudo-membrane from the larynx nearly as fast as it is formed. For this purpose M. Marotte employs one or other of the following formulæ:

1. Tartar emetic, 1½ gr.; syrup of ipecacuanha, 1 oz.; water, 2 oz.

2. Impure emetine, 3 gr.; syrup of ipecacuanha and water, of each, 1½ oz.

These draughts are administered by spoonfuls every 10 minutes, until there has been a sufficient number of vomitings. In this manner he says he has been always able to make the patient expectorate a certain quantity of false membrane. This treatment is accompanied by the use of small doses of calomel, leeches to the throat, and blisters to the nape of the neck; but it is the opinion of M. Marotte that the vomitings alone effect the cure. Out of 25 cases that occurred at the Hôpital des Enfans, the only authenticated case of cure among all these was effected by emetics. (*M. Boudet.*)

The depression produced by the tartar-emetic must be watched carefully; frequent small blisters on the chest or moist warmth to the legs and feet are very useful; stimulants in small doses of brandy or ammonia are generally indicated. Milk, or beef-tea and milk, or arrowroot made with milk and a little brandy is the best diet.

Croup is a very dangerous disease, and medical aid should be immediately sought wherever it can be procured. It is principally confined to infancy, or to children under nine years of age; but occasionally attacks adults.

CROWDIE. Mix the liquor in which a leg of mutton has been boiled with ½ a pint of oatmeal, and two onions cut very fine; and add pepper and salt. Make the oatmeal into a paste with a little of the liquor over the fire, stir in the remainder of the ingredients, and let them boil gently for 20 minutes. This forms a very nutritious and cheap dish.

CROWING, IN CHILDREN. *Syn.* CHILD-CROWING, SPURIOUS CROUP, SPASMODIC CROUP. A slight inflammation of the larynx and air-passages; occurring chiefly in young children, with attacks of spasmodic cough and difficulty of breathing, coming on usually at night and terminating favourably in a few days. An ordinary cold is the common predisposing cause. In the intervals between the spasms the respiration is quite natural; but during the attack there is great difficulty of breathing, accompanied with a crowing noise and with violent struggling on the part of the patient.

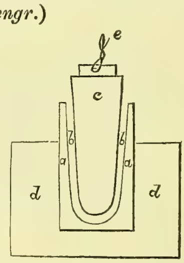
False croup generally yields readily to simple treatment; but it may be a dangerous disorder, passing into pneumonia or other lung complications, and should therefore be promptly and carefully treated.

CROWN BARK. PALE CINCHONA, *Cinchona officinalis*, L.

CRU'CIBLE *Syn.* MELTING POT; CRUCIBULUM, L.; CREUSET, Fr. A vessel used by metallurgists and chemists for holding substances whilst they are exposed to a high temperature. The crucibles commonly used for fusing metals are formed of clay, or a mixture of plumbago and clay. For certain purposes, crucibles of platinum, silver, iron, porcelain, and lime, are employed.

Crucibles, Earth"en. *Syn.* CLAY CRUCIBLES. From fire-clay mixed with silica, coke, burnt clay, or other infusible matter.

Manuf. The materials, having been ground and kneaded, are generally moulded by hand upon a wooden block of the shape of the cavity of the crucible. Another method of shaping a crucible consists in ramming the ingredients into a suitable mould formed of steel or gun-metal. (See *engr.*)



a a, External steel mould.

b b, Clay or composition for forming the crucible.

c, Internal steel mould.

d d, Wooden stand.

e, Cord or chain to withdraw the internal mould or plug.

Small crucibles are sometimes formed by pouring 'slip,' that is, clay mixed with sufficient water to give it the consistence of cream, into porous moulds, made of a species of stucco. A series of these moulds are placed upon a table and filled with the semifluid composition. By the time the whole (say 50 or 60) are filled, the 'slip' may be poured out of the one first filled, leaving only a very small quantity behind to give the requisite thickness to the bottom. The second and third may then be treated in the same

way, until the whole number have been attended to. In each mould a perfect crucible is formed by the abstraction of the water of that portion of the 'slip' in immediate contact with the stucco, and the crucible is either thicker or thinner in proportion to the time this absorbent action has been allowed to go on. 70 or 80 crucibles may thus be hastily made in less than 15 minutes. The moulds and their contents are next placed in a stove or slow oven. In a short time, from the contraction of the clay in drying, the crucibles may be removed, and the moulds, as soon as they have become dry, may be again filled; with care they will last for years.

Earthen crucibles are used both in the burnt and the unburnt state. Small crucibles are generally kiln-burnt before they are used, but the large Stourbridge-clay 'casting-pots,' which are extensively employed in brass foundries, are never previously burnt.

The following kinds of earthen crucibles are much used in the arts:

Crucibles, Cornish. From Teignmouth clay, 1 part; Poole clay, 1 part; sand from St Agnes's Beacon, Cornwall, 2 parts. When smaller and less refractory crucibles are needed, the mixture is employed, with the addition of 1-8th part of China clay, or Kaolinite from St Austell. These crucibles are generally made round, and of two sizes, of which one fits into the other; the larger being 3 inches in diameter at the top, and 3½ inches high outside measure. They are coarse in grain, and of a greyish-white colour, spotted with dark specks. They are always kiln-burnt. Of all crucibles, none are more generally useful for metallurgical experiments.

Crucibles, Hessian. From a mixture of equal weights of Almerode clay and sand. They are generally triangular in shape, so that the melted metal may be conveniently poured out from each corner. They are usually sold in 'nests' of six crucibles, fitting one in another. In the character of their body and in composition and qualities they closely resemble the Cornish.

Crucibles, London. From a very refractory clay. They have a reddish-brown colour, and are close in grain. They are exceedingly useful in assaying, as they resist the action of fused oxide of lead much better than most clay crucibles. Being very liable to crack, they require to be used with care.

White Fluxing-pots. From a peculiar kind of foreign clay. They are manufactured by the Patent Plumbago Crucible Company, and are much esteemed by metallurgists, being well moulded and very refractory. They have a smooth surface, and withstand the action of fluxes satisfactorily.

Crucibles, Stourbridge-clay. From Stourbridge clay, 4 parts; burnt clay, obtained by pounding and grinding old glass pots, 2 parts; pipe-clay and coke-powder, of each, 1 part.

Anstey's Patent. From Stourbridge clay, 2 parts; hard gas-coke (previously ground and sifted through a sieve of 1-8th inch mesh), 1 part.

Obs. These crucibles of Stourbridge clay are made large enough to hold 40 lbs. or more of melted brass. They are only dried, and not baked. For use they are warmed, placed on the furnace, bottom upwards, the burning coke gradually heaped round them, and the firing continued until they acquire a fully red heat. They are then quickly taken out of the furnace, and put in again with the mouth upwards. If placed in the furnace with the mouth upwards at first, they are sure to crack. After they have been once used and allowed to become cold they are worthless.

Crucibles, Iron. Used chiefly for preparing common reagents, as sulphide of iron, calcic chloride, &c.

Crucibles, Plat′inum. They are indispensable instruments in the laboratory of the analytical chemist. They are chiefly employed in the ignition of precipitates, and in the fusion of silicates with alkaline carbonates to render them soluble, a preliminary step to their analysis. The most ordinary form of the platinum crucible is that of a cup with a flat bottom. They are always provided with lids, which are sometimes so constructed that they may be used, when separated from the crucibles, as capsules for ignitions and evaporations.

Precipitates of the more reducible metals must never be ignited in these crucibles, as the reduction of the metals would infallibly destroy the vessels.

Crucibles, Silver. These are sometimes used for fusions of alkalies, and for water analyses. They are cheaper than platinum crucibles, but are easily destroyed by acids.

Crucibles, Plumbago. *Syn.* Graphite c., Black-lead c., Blue pots. From graphite ground and sifted, mixed with sufficient refractory clay to render it plastic. They are shaped by hand on an ordinary potter's wheel, or by moulds of metal like that figured above under the head of Crucible, Earthen.

Prop., &c. Good black-lead crucibles, even when of the largest size, support the greatest and most sudden alternations of temperature without cracking, and may be used after repeated heating and cooling. Their surface, within as well as without, may be made very smooth, so that particles of melted metal will not hang about the sides. They are now almost universally used for melting the precious metals.

Crucibles, Por′celain. These beautiful vessels are now made in Germany and France of all shapes and sizes. They are formed of the most exquisitely white, thin, and hard porcelain, which does not crack when heated, and which is but little acted on by the most energetic chemical reagents.

They are largely used for the ignition of precipitates not requiring a very high temperature. In some cases, crucibles of platinum must be used, as in the ignition of magnesium ammonium phosphate, to convert it into magnesium pyrophosphate, a process in the estimation of phosphates.

Porcelain crucibles do not retain colouring matter, and are not porous. Their covers are excellently adapted for delicate cases of testing, the whiteness of the porcelain showing the changes of colour in a single drop of liquid most distinctly.

CRUCIFER ORDER (Cruciferæ). Nearly all herbaceous, abounding in the temperate countries of the northern hemisphere. They are called Cruciferæ (cross-bearing) from the four flower leaves (petals) being disposed, more or less distinctly, in the form of a cross, as in the wallflower, cabbage, and cress, familiar examples of the order. None are poisonous, though they generally are a little acrid; they are especially antiscorbutic.

CRUMP'ET. A sort of muffin or tea-cake, very light and spongy. *Prep.* From flour, 2 lbs., made into a dough with warm milk-and-water, adding a little salt, 3 eggs (well beaten), and 3 teaspoonfuls of yeast, mixed to the consistence of thick batter; after standing before the fire for a short time, to rise, it is poured into buttered tins, and baked slowly to a fine yellow. For the table, crumpets are toasted lightly on both sides, buttered, piled on a hot dish, and cut into halves.

CRUST. The paste with which pies, tarts, &c., are made, or covered.

1. (Fine.) From flour, 1 lb.; sugar, ¼ lb.; melted butter, ½ lb.; 3 eggs; milk, q. s. Requires little baking.

2. (Raised crust, for meat pies, &c.) As the last, but using 6 oz. of lard for the butter, and 2 instead of 3 eggs.

3. (Short.) From flour, 1 lb.; butter and sugar, of each, 2 oz.; eggs, 2 in number; made into a stiff paste.

Obs. The quality is improved if the whole or a portion of the butter is employed in the way directed under Puff paste. For further information hereon, consult the cookery books of Acton, Beeton, Rundell, and Soyer.

CRY'OLITE. $3NaF.AlF_3$. A native double fluoride of aluminium and sodium, found in large quantities in Greenland, employed in the manufacture of alum, and also as a source of metallic aluminium.

CRYOPH'ORUS. See Refrigeration.

CRYS'TAL. A solid body, having a regular geometrical form. The plane surfaces by which a crystal is bounded are termed faces; these intersect in straight lines or edges; and these again meet in points, and form angles. The axis of a crystal is an imaginary line passing through its centre, and terminating either in the middle of two faces or of two edges, or in two angles; and axes terminating in similar parts of a crystal are named similar axes. When the axes of a crystal are properly chosen and placed in a right position, the various faces are observed to group themselves in a regular and beautiful manner around these axes, and to be all so related to them as to compose a connected series, produced according to definite laws. The multitudinous forms of crystals have been distributed by mineralogists and chemists into six primary classes or systems, distinguishable from one another by the relative positions and lengths of the three axes about which the planes or faces are arranged; while the different figures of any particular system are distinguishable by the arrangement of the planes in respect to the axes. Thus, the cube or hexahedron, the rhombic dodecahedron, and the octahedron all belong to the regular system, which is characterised by three equal axes cutting one another at right angles. But in the cube each plane cuts one axis, and is parallel to two axes; in the dodecahedron each plane cuts two axes, and is parallel to a third; while in the octahedron each plane cuts the three axes. The names and definitions of the six crystalline systems are given below:

1. Regular, Isometric, or Cubic System. Three axes at right angles, all of them equal.

2. Quadratic, Tetragonal, or Square Prismatic System. Three axes at right angles; two of them equal, the third unequal.

3. Hexagonal, or Rhombohedral System. Three equal axes lying in one plane and making equal angles (120°) with each other, and a fourth, passing through the point of intersection of these three and perpendicular to the plane in which they lie; this last is not necessarily equal to the other three.

4. Rhombic, Orthorhombic, or Prismatic System. Three axes at right angles, none of them equal.

5. Monoclinic or Clinorhombic System. Two axes not at right angles, and a third passing through the point of intersection of these two, and perpendicular to the plane in which they lie. None of the axes are necessarily equal.

6. Triclinic or Anorthic System. Three axes passing through a point, but no two of them at right angles, and none of them necessarily equal.

CRYSTALLISATION. The act or process by which crystals are formed. The frequent reference to this subject in the pages of this work, and the constant employment of the process of crystallisation in the manufacture of salts, &c., in the laboratory, seem to point to the necessity of a few explanatory remarks thereon under this head. When fluid substances are suffered to pass with adequate slowness to the solid state, or when solutions of solids are slowly concentrated by evaporation, or the solvent powers of the menstruum gradually lessened by cooling, the ultimate particles of matter frequently so arrange themselves as to form regular geometrical bodies, familiarly known by the name of crystals. This wonderful property, which is possessed by a great variety of substances in the mineral kingdom, and by nearly all saline bodies, is resorted to for many useful and important purposes in the chemical arts. It is by means of crystallisation that the majority of salts are obtained in a state of purity; for in the act of passing into the crystalline state the foreign substances with which they are united are left behind in the mother-liquor.

Salts are crystallised either by allowing their hot and saturated solutions to cool slowly or by simply evaporating the menstrua as long as crystals form. In the first case the liquid is commonly evaporated until a pellicle appears on the surface, when the vessel is set aside in some sheltered situation until cold, when the crystals are collected and the process repeated for fresh crystals. In the second case the crystals are usually removed from the liquid by means of a perforated ladle as soon as they are deposited, the process being technically known as 'fishing.' The first method is adopted for those salts that are considerably more soluble in hot than in cold

water, as carbonate of soda, Epsom salts, &c.; the last method, for those that possess nearly equal solubility in both cases, and also for many salts which are not required in handsome crystals; thus common salt and chromate of potash are crystallised in this way. Many of the alkaloids and their salts are obtained in crystals by allowing their solutions (generally alcoholic or ethereal) to evaporate spontaneously. By repeating the processes of solution and crystallisation two or three times with the same body, the crystals obtained by the last operation will usually be found to be quite pure.

Many solids may be readily obtained in a crystalline state by melting them and allowing them to cool very slowly. Thus, iodide of sulphur is crystallised by melting it in a flask placed in a salt-water bath, and allowing it to remain in the water until the whole becomes cold. Sulphur and many metals are crystallised by pouring them, in a state of fusion, into a hot vessel having a plug in the bottom, which is withdrawn as soon as the surface becomes cool, when the liquid portion runs out, and leaves the under surface of the solid crust in the form of a mass of agglomerated crystals. Perfectly pure wax, stearine, and spermaceti have a very pleasing appearance when treated in this way.

CRYS'TALLOID. See DIALYSIS.

CU'BEBIN. $C_{10}H_{10}O_3$. A peculiar substance obtained from cubebs.

Prep. From cubebs (from which the oil has been expelled by distillation), by digestion in alcohol, evaporating the resulting tincture to 1-4th, filtering, and then evaporating the remaining fluid almost to dryness. The residuum is left in a cold place until it assumes a semi-crystalline appearance, when it is thrown on a filter, and the fluid portion (the 'cubebine' of M. Cassola) allowed to drain off. In 24 hours the substance left on the filter is dissolved in 4 times its weight of boiling alcohol (sp. gr. ·90), the solution allowed to deposit its undissolved resin (still maintaining it near the boiling temperature), after which the clear portion is decanted. The crystals deposited as the liquid cools are cubebin. It is purified by redissolving it in boiling concentrated alcohol and the addition of a little boiling water and animal charcoal, when long white needles will be deposited if the solution is allowed to cool very slowly.

Prop., &c. It is insoluble in water, and nearly so in cold alcohol, but very soluble in boiling alcohol. It strikes a fine crimson colour with sulphuric acid, which remains unaltered for some hours; a property which distinguishes it from piperin. Its physiological action has been but little studied. According to Dr Görres, this for the most part resembles that of cubebs.

CU'BEBS. *Syn.* CUBEB PEPPER; CUBEBA (B. P. and U. S.), CUBEBÆ (B. P.). The immature and stalked fruit of *Piper cubeba* or *Cubeba officinalis.* Cubebs are about 1-6th inch in diameter, blackish, wrinkled, tapering below into a rounded stalk, which is continuous with and permanently attached to the pericarp. Taste warm, aromatic, and bitter. A cold decoction, gives a blue colour with solution of iodine. This drug is often adulterated with fruits similar to it in appearance; one of them is the *Piper crassipes,* which is larger than the cubebs, of a lighter colour, the stalk being more flattened. Another adulterant is *Daphnidium cubeba,* same size as cubebs; stalk articulated, usually absent; contains no starch. Cubebs are stimulant, stomachic, and aromatic, like the other peppers; they are also diuretic, and appear to possess a specific influence over the urino-genital organs.—*Dose,* 10 to 20 gr., in affections of the bladder and prostate gland, and in gleet and leucorrhœa; 1 to 3 dr., in the early and inflammatory stages of gonorrhœa, in piles, &c. They may be taken in water, milk, or bitter ale.

CU'CUMBER. The fruit of *Cucumis sativus,* Linn. Used as a salad vegetable. It is somewhat indigestible, but when properly dressed, with plenty of oil, it may be eaten without the slightest fear of evil consequences. The practice of pouring off the natural juice extracted from the cucumber by salt cannot be too strongly condemned.

Cucumber, Squirting (*Ecballium elaterium,* A. Rich.), a prostrate perennial herb, common in waste places in the south of Europe. The active principle, *elaterium,* is prepared from the juice which flows from the fruit when nearly ripe; it is used as a very powerful cathartic. See ELATERIUM.

CUD'BEAR. *Syn.* PERSIO. A dye-stuff obtained from *Lecanora tartarea* and other lichens, by a process nearly similar to that used in making ARCHIL. The lichen is watered with stale urine or other ammoniacal liquor, and suffered to ferment for 3 or 4 weeks, after which the whole is poured into a flat vessel, and exposed to the air until the urinous smell has disappeared, and it has assumed a violet colour. It is then ground to powder. Its use is confined to a few cases of silk dyeing, where it is employed to yield shades of ruby and maroon; upon wool it gives deep-red shades. The colours produced by it are very fugitive. Like archil, there are two varieties of this dye-stuff—BLUE CUDBEAR and RED CUDBEAR. See ARCHIL.

CUDDAPAH ALMONDS. See ALMONDS.

CULM. In *mineralogy,* a slaty kind of ANTHRACITE, occurring in Wales and North Devon. The term is also applied to any impure, shaly kind of coal.

CULVERS ROOT (*Veronica virginica,* L.), a native of the Eastern United States, where it is used in medicine.

CU'MARIN. See COUMARIN.

CU'MIN. *Syn.* CYMINI SEMINA, CYMINUM, L. The fruit (seed) of *Cuminum cyminum.* An annual herb cultivated from earliest times in the Mediterranean countries, used chiefly as a condiment in India, and as a constituent in curry powder, also to a small extent in medicine and in veterinary practice. Cumin fruits are exported from Morocco, Sicily, Malta, Bombay, and Calcutta. It is carminative and aromatic, like the caraway and anise. See PLASTER.

CU'MINOL. A colourless, transparent oil, of powerful odour. It exists with CYMOL in OIL OF CUMIN. See CYMOL.

CUPANIA EDULIS, Schum. and Thon. =

Blighia sapida, Kg. Akee. A tree of Western Africa. The edible portion is the aril, the succulent socket developed round the base of each seed. The seeds contain a small quantity of solid oil or fat obtained by pressure.

CUPELLA'TION. The process of assaying gold and silver and their alloys by means of the CUPEL. See ASSAYING.

CUP'PING. This method of topical bleeding is performed as follows:

The skin being softened by means of a sponge and warm water, and the hair and other extraneous substances being previously removed, one of the small bell-like glasses (CUPPING-GLASSES; CUCURBITU'LÆ), having the air contained in it rarefied by being passed over the flame of a spirit-lamp, is immediately applied to the part. From the formation of a partial vacuum beneath the cup, the pressure of the air on the surrounding surface causes that portion immediately under the cup to swell, and the vessels to become turgid. When this has taken place the cup is removed, and several incisions are instantly made by means of a scarificator, an instrument containing numerous lancets, which, by means of a spring, make a number of incisions at the same moment, the depth of these incisions being regulated by means of a screw which protrudes or withdraws the lancets, according to the vascularity of the part or the quantity of blood to be abstracted. The cupping-glass is now again applied. When a sufficient quantity of blood has been collected in the cup, it is removed by gently introducing the nail of one of the fingers under the upper edge, by which means, air being allowed to enter, the cup becomes detached. The part being washed with warm water to remove any clots of blood, another cup is applied as before, and the operation continued until a sufficient quantity of blood is withdrawn. Sometimes, especially when applied to the scalp, the cups fill so rapidly with blood as to become detached almost immediately on being applied. This method of local bleeding is frequently called 'CUPPING WITH SCARIFICATIONS.'

When cupping-glasses are applied without the use of the lancet or scarificator the operation is called 'DRY CUPPING,' and is much used to cause a speedy irritation of the skin and reaction, for the relief of oppressive breathing, local pains, &c. To obtain the full benefit from this operation, the cups should be suffered to remain upon the part until they cause an exudation of a small quantity of serum, or a considerable amount of irritation of the part. Dry cupping has been found extremely beneficial in poisoned wounds, as it acts not only by abstracting the poison, but also by the pressure the glasses exercise on and around the part, in preventing the absorption of it.

Obs. For the operation of cupping, a basin of hot water, sponges, and clean, soft towels, should be provided. In clumsy hands, cupping is occasionally a severe and painful operation; but this is not the case with the skilful operator. A good cupper does not exhaust much of the air in the cup before applying it, but simply passes its mouth rapidly over the flame of the lamp. When it is held over the flame even for a few seconds, the compression of the edge of the cup upon the skin is so great that it checks the flow of the blood to the scarified part. A good cupper also removes the cup without spilling the contents, and completes the whole operation quickly and neatly. There are, however, few persons, who are not professional cuppers, who are sufficiently expert to exhaust the air in the cup by means of the common lamp; although it is by far the best. A good plan is to rarify the air in the cup by means of a small cone of paper dipped in spirits of wine or strong brandy; this is ignited and thrown in the cup, which is instantly to be applied to the proper spot. Where cupping-glasses and the scarificator are not to be had, wine-glasses or any very small tumblers, may be substituted for the first; and small incisions by means of a thumb lancet will answer the purpose of the other.

The cicatrices of the scarification leave permanent marks on the skin; on which account, when blood is to be drawn from the head or neck, the glasses should be applied behind the ears, and a portion of hair removed in such a manner that the part may be covered by what remains.

CUPREA BARK. The bark of *Remijika purdiena* and *R. pedunculata*. These barks, though distinct from the cinchonas, are employed in the manufacture of the cinchona alkaloids; they yield quinine, homoquinine, and cupreina. The trees are found growing on the lower mountain ranges adjoining Buccaramanga, States of Columbia.

CURAR'INE. *Syn.* CURARIA. The vegeto-alkaline base of curara, urari, woorara, woorali, or wourali, the arrow-poison of Central America. Produced from a species of *Strychnos* and other plants.

In physiological effects curarine is antagonistic to strychnia, a fact which has led to its being proposed as an antidote for the latter poison. Curarine is also said to have been employed in Germany in the treatment of hydrophobia with such success that the patient to whom it was administered recovered. It is a most potent poison, and should not be allowed to come into contact with the fingers.

CURB. In *horses.* An enlargement at the back of a horse's hock caused by injuring a ligament in this region. See SPRAIN.

CURCU'MIN. The yellow colouring matter of turmeric, obtained by digesting the alcoholic extract of the powder in ether, and evaporating the clear ethereal solution to dryness. A brownish-yellow mass, yielding a bright yellow powder. It is scarcely soluble in water, but very soluble in both alcohol and ether. Boracic and hydrochloric acid redden it; alkalies turn it reddish brown.

CURD. Coagulated casein. See CHEESE.

CURRANT CLEARWING, The (*Ægeria tipuliformis*, Westwood). Frequently in currant plantations and in gardens it is seen that the ends of the shoots of the bushes of black, red, and white currants die off. This extends sometimes to all the shoots and branches, so that the whole bush is killed, and it is attributed generally to the unsuitable conditions of the soil or subsoil, or to some natural unhealthiness of the bush. Upon a close investigation of the injured part, it will be seen that the pith of the shoot or branch is perforated; and if the shoot is cut through longitudinally distinct traces of a boring insect will be

visible, and at the end of the burrow the caterpillar itself will be found if it has not assumed the garb of the moth and flown away. Professor Lintner describes this insect as destructive to currant trees in the United States, and remarks that it was imported from Europe ('First Annual Report of the Summer and other Insects of the State of New York,' by J. A. Lintner). It is well known in Germany, and in France.

Life History. This moth belongs to the family *Ægeriidæ.* The body is nearly 8 lines long, and ends with a kind of brush, and is of a lustrous black or very dark blue colour, having yellow bands round it. About the beginning of June the perfect insect appears, and deposits its eggs upon the currant stems. Shortly after this the larva is hatched and bores into the stem to the pith, where it remains in larval condition until the spring, and then the pupal state is assumed. The larva or caterpillar is large and fleshy, of a dirty white colour, having 16 feet.

Prevention. When the tips of the currant bushes die examination should be made to discover if there are caterpillars within the shoots. In this case all those shoots that show any signs of withering must be cut off and burned. As the cuttings of fruit bushes and trees are harbours for all kinds of insects injurious to them, it is highly important that they should be removed at once after they are cut off, and burned. This should be insisted upon by all fruit growers, and particularly after an attack of insects ('Reports on Insects Injurious to Crops,' by Charles Whitehead, Esq., F.Z.S.).

CUR'RANTS. The currants of our gardens are varieties of the *Ribes rubrum* and *Ribes nigrum*, Linn. The first includes RED CURRANTS and WHITE CURRANTS; the fruit of both of which are gently acidulous, cooling, and wholesome. The juice makes excellent wine. The fruit of the last (BLACK CURRANTS, QUINSY-BERRIES) is aperitive, and has been used in calculous affections; the juice is made into wine, jellies, jams, lozenges, &c. The young leaves are used as a substitute for tea; 1 or 2 buds or ½ a small leaf impart to black tea the flavour and fragrance of green. The currants of the grocers (ZANTE CURRANTS) are a small variety of dried grapes. The word 'currant' is a corruption of Corinth, whence the fruit originally came.

CUR'RY. *Syn.* CURRIE. A noted dish in Indian cookery, much esteemed throughout the East. Curries are simply stews, of which rice usually forms a characteristic ingredient, highly flavoured with fried onions and curry powder, to which sliced apples and lemon juice are sometimes added. They are made from every variety of fish, meat, poultry, game, &c., according to the fancy of the parties.

To make a Dish of Curry. Cut an onion into slices and fry it with an apple, finely chopped, in 2 oz. of dripping; then add slices of cold meat; mix a dessert-spoonful of curry powder and 1 of flour in ½ a pint of water; pour it over the meat, and shake the whole over the fire till it boils. The meat should never be more than warmed through; if re-cooked it will be tough and tasteless.

Cur'ry Powder. *Prep.* (*Kitchener.*) From coriander seed, ¼ lb.; turmeric, ¼ lb.; cinnamon seed, 2 oz.; cayenne, ½ oz.; mustard, 1 oz.; ground ginger, 1 oz.; allspice, ½ oz.; fenugreek seed, 2 oz.; all dried thoroughly, pounded in a mortar, rubbed through a sieve, and mixed together.

The famous Ceylon curry powder is said by Dr Balfour to have the following rather indefinite composition:—A piece of green ginger, 2 fragments of garlic, a few coriander and cumin seeds, 6 small onions, 1 dry chili, 8 peppercorns, a small piece of turmeric, ½ a dessert-spoonful of butter, ½ a cocoa-nut, and ½ a lime. For it to be in perfection the powder should be made the day on which it is cooked.

Obs. The above must be regarded as merely a substitute for Indian curry powder, which contains many ingredients not to be obtained in England. It should be kept in a bottle closely corked or stoppered. The curry powder sold at the present time consists of coriander seed, turmeric, cayenne, fenugreek seed, and a large proportion of sago-flour.

CUS'CONINE. See ARICINE.

CUSPA''RIA. *Syn.* CUSPARIA BARK (B. P.), ANGOSTU''RA B.; COR'TEX ANGOSTU''RÆ, C. CUSPA''RIÆ, CUSPARIA (Ph. L. and E.), L. "The bark of *Galipea cusparia*" (Ph. L.), or *Galipea officinalis* (Ph. E.). A drug, imported directly or indirectly from South America.—*Dose*, 10 gr. to 30 gr., as a tonic, stomachic, and febrifuge, in similar cases to those in which CASCARILLA, CALUMBA, and CINCHONA are commonly given.

Characters.	False Angostura.	True Angostura.
Form	Thick, rugous, rolled upon itself. Edges cut perpendicularly	Flat or rolled up, little wrinkled, edges bevelled.
Colour	Brown, or greenish-yellow, presenting protuberances or excrescences produced by the great development of the corky layer, which has a still more yellow colour	Greenish-yellow.
Taste	Very bitter	Bitter.
Reaction with Nitric Acid	Red colour when dropped upon the bark	Yellow colour.

Angostura or cusparia bark has fallen into comparative disuse, in consequence of nux vomica or false angostura bark having formerly, in several instances, been mistaken for it, and administered with fatal results. The leading characteristics of these two barks have been pointed out by M. Gibourt.

CUSPAR'IN. *Syn.* ANGOSTU''RIN, ANGOSTU''RA. The bitter principle of Cusparia bark. It is neutral; crystallises in tetrahedrons; is easily fusible; soluble in rectified spirits, in acids, and in alkaline solutions. It is precipitated of a whitish colour by tincture of galls.

CUSTARD. A composition of milk, or cream, and eggs, sweetened with sugar, and variously

flavoured. Custards may be cooked either in the oven or stewpan.

Prep. 1. (*Soyer.*) Milk (boiling), 1 pint; sugar, 2 oz.; thin yellow peel of half a lemon; mix, and set it aside for a short time; then take eggs, 4 in number, beat them well in a basin; add, gradually, the milk (not too hot), pass the mixture through a colander or sieve, and fill the custard cups with it; these are then to be placed over the fire in a stewpan, containing about 1 inch of hot water, and left there for 12 minutes, or till sufficiently set. The above is for PLAIN CUSTARDS; but it forms a good basis to receive any of the usual flavouring ingredients, as fresh or stewed fruit, peels, essences, orange-flower water, brandy, or other spirits, &c.

2. (*Rundell.*) As the last, but using cream instead of milk, or equal parts of the two, with 2 additional eggs. Very rich; like the last, any suitable flavouring matter may be added to it.

3. (ALMOND CUSTARDS,—*Rundell.*) As either of the above, adding blanched sweet almonds, 4 oz.; bitter do., 6 in number; beaten to a smooth paste.

4. (BAKED CUSTARDS, — *Rundell.*) From cream, 1 pint, with 4 eggs; flavoured with mace, nutmeg, and cinnamon, and add a little white wine, rose-water, and sugar; bake in cups.

5. (COFFEE CUSTARD,—*Soyer.*) Hot milk and strong-made coffee, of each, ½ pint; sugar, 2 oz.; dissolve, and add it, gradually, to 4 eggs (well beaten), and proceed as in No. 1. Chocolate custards and cocoa custards are made in the same way.

6. (COLD CUSTARD, FOR INVALIDS,—*Dewees.*) 1 egg; sugar, a tablespoonful; beat well together, and add, gradually, constantly stirring, cold water, ½ pint; rose-water, 2 teaspoonfuls; and a little grated nutmeg. An agreeable and nutritious demulcent. A wineglassful every 2 or 3 hours, or *ad libitum.*

7. (LEMON CUSTARDS,—*Rundell.*) *a.* As No. 1 (nearly), using a little more lemon peel. In the same way orange custards are made, but using orange peel.

b. From candied lemon peel and lump sugar, of each, 2 oz., beaten in a mortar quite fine, and added to either No. 1 or No. 2. Orange and citron custards may be made in the same manner. A little orange-flower water, or marsala, or sherry may be also added at pleasure. They are best baked.

8. (ORANGE CUSTARDS.) As *above*, No. 7, *a* and *b.*

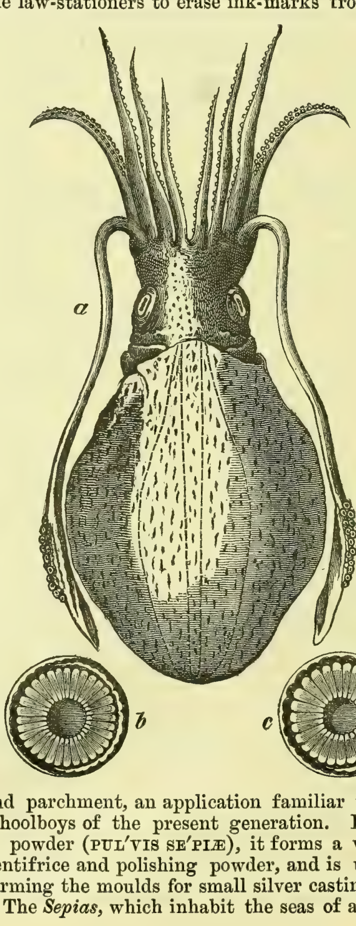
9. (RICE CUSTARDS,—*Rundell.*) Boil ½ a cupful of the best ground rice in a pint of milk until dissolved, then mix it with a quart of cream; flavour with nutmeg, mace, and a little brandy, and put it into a cup or a dish.

CUTCH. See CATECHU.

CUTS. These are incised wounds of greater or less extent, and must be treated accordingly. A cut should be thoroughly washed with tepid water containing a little carbolic acid or other simple disinfectant, to remove all dirt or other matter which may have been carried into the wound. The divided parts should then be drawn close together, and held so with small pieces of strapping or adhesive plaster stretched across the wound. When the wound is large and it is much exposed, a good method is to sew the parts up. The application of a little creosote or a spirituous solution of creosote will generally stop local bleeding, provided it is applied to the clean extremities of the wounded vessels. A good way is to place a piece of lint, moistened with creosote, on the wound, previously wiped clean, or to pour a drop or two of that liquid on it. An excellent method is to cover the part with a film of collodion. Friar's balsam, quick-drying copal varnish, tincture of galls, copperas water, black ink, &c., are popular remedies applied in the same way. A bit of the fur plucked from a black beaver hat is an excellent remedy to stop the bleeding from a cut produced by the razor in shaving. A cobweb is said to possess the same property.

The fine threads and points presented by these and similar materials, greatly assist the coagulation of the blood. See BLEEDING.

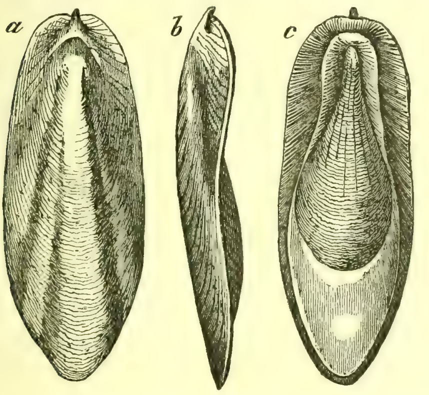
CUTTLE-FISH. The bone or skeleton of the *Sepia officinalis* of Linnæus, or common cuttle-fish (CUTTLE-FISH BONE; OS SE'PIÆ), is used by the law-stationers to erase ink-marks from paper



and parchment, an application familiar to most schoolboys of the present generation. Reduced to powder (PUL'VIS SE'PIÆ), it forms a valuable dentifrice and polishing powder, and is used for forming the moulds for small silver castings.

The *Sepias,* which inhabit the seas of all quar-

ters of the globe, like the other *Cephalopoda*, are carnivorous. They are able to exercise considerable locomotive powers, by means of their tentaculæ or arms which surround the mouth,



and which are usually provided with numerous suckers. Head downward, they walk on these arms at the bottom of the ocean. The *Sepias* are also fleet swimmers; effecting their progress through the water either by making the expansion of their skin perform the same office as fins, or by the forcible projection of water from the cavity of their mouths, the reaction accompanying which operation drives them raidly through the water in a different direction. They are provided sometimes with 8 and sometimes with 10 tentaculæ, and have naked bodies. The black fluid which the animal is capable of ejecting from its ink-sac, when pursued by its enemies, was formerly employed in the manufacture of the pigment called from its source ' sepia.'

Several species are used as food on the Mediterranean coasts; the large ones are tough and indigestible, the small varieties make good soup.

CYANATE. *Syn.* Cy'anas, L. A salt of cyanic acid.

CYANIC ACID. HCNO. *Syn.* Acidum cyan'icum, L. *Prep.* Cyanuric acid, deprived of its water of crystallisation, is distilled in a retort, and the product collected in a well-cooled receiver.

Prop, &c. Cyanic acid is a limpid, colourless liquid; it reddens litmus; is sour to the taste; possesses a modified sulphurous odour, similar to that which is always perceived when any of its salts are decomposed by an acid; it forms salt with the bases called cyanates; when in contact with water it suffers decomposition in a few hours, and is converted into bicarbonate of ammonia; it cannot be preserved for any time, as shortly after its preparation it spontaneously passes into a white, opaque, solid mass, to which the name cyamelide has been given. By distillation this new substance is reconverted into cyanic acid.

CY'ANIDE. *Syn.* Cyan'idum, L. The compound formed by the union of cyanogen with a metal or other radical. See Cyanogen, Hydrocyanic Acid, and the respective bases.

Cyanide, Al'kaline. *Syn.* Crude cyanide of potassium and sodium. *Prep.* (*R. Wagner.*) Dry ferrocyanide of potassium, 4 parts; dry carbonate of soda, 1 part; are melted together in an iron crucible at a red heat, and continually stirred until the iron rod comes out covered with a white crust, when the heat is withdrawn, and after a few moments' repose the supernatant liquid portion is poured out on a clean iron slab. This crude mixed cyanide is quite as useful as the more expensive one of Liebig, and is equally fit for technical applications, as electrotyping, gilding, silvering, &c. See Potassium, Cyanide of.

CY'ANINE. A base discovered by Mr G. Williams in chinoline blue. See *below*.

Cyanine, I'odide of. *Syn.* Chin'oline blue. The action of iodide of amyl upon chinoline gives rise to hydriodide of amylchinoline. Addition of excess of soda to an aqueous solution of this iodide produces a black resinous precipitate which dissolves in alcohol with a magnificent blue colour. This precipitate is the iodide of cyanine, or chinoline blue. Many attempts have been made to use it in dyeing; they have, however, failed on account of the instability of the colour.

CYAN'OGEN. CN or Cy. A highly important compound radical or quasi-element, discovered by M. Gay Lussac in 1815.

Best obtained by carefully igniting dry cyanide of mercury in a small retort, and collecting the gas over mercury.

Prop., &c. A colourless gas, possessing a pungent and peculiar odour, resembling that of peach-kernels or prussic acid; under a pressure of about 4 atmospheres, at a temperature of 45° F., it assumes the liquid form (*Faraday*), and this fluid again becomes gaseous on withdrawal of the pressure. Water absorbs nearly 5 times its bulk of cyanogen at 60° F., and alcohol about 23 times its volume; with hydrogen it forms hydrocyanic acid, and with the metals a most interesting and important class of bodies called cyanides; when kindled, it burns with a beautiful purple flame, carbonic acid and nitrogen being evolved. Sp. gr. 1·806. See Hydrocyanic acid, &c.

A bromide and iodide of cyanogen are formed when cyanide of mercury is distilled with bromine or iodine; these are colourless, volatile, highly poisonous solids. Two isomeric chlorides are known: one a very volatile liquid, prepared by passing chlorine over moist cyanide of mercury; and the other, in white volatile needles, by exposing aqueous hydrocyanic acid to chlorine in sunshine.

CYANU''RIC ACID. $H_3C_3N_3O_3$. A peculiar acid, discovered by Scheele. It is a product of the decomposition of the soluble cyanates by dilute acids, or of urea by heat, &c. When heated it yields cyanic acid.

CY'DER. See Cider.

CY'DONINE. The peculiar gum of quince seed. It resembles bassorin in most of its properties.

CYMENE. *Syn.* Cymol. A peculiar hydrocarbon found in oil of cumin, in admixture with cuminol. The two bodies are separable in a great measure by distillation, cymene being the most volatile portion of the oil.

CY'MIDINE. An oily base, homologous with aniline, obtained by the action of iron filings and acetic acid on nitro-cymol.

CYNAPINE. An alkaloid obtained from *Æthusa cynapium,* or fool's-parsley. It possesses no practical interest.

CYPRESS WOOD (*Cupressus sempervirens,* L.). An aromatic, compact, and almost imperishable wood, frequently used in Italy as well as in England in the 15th century for making chests principally for keeping dresses and tapestries, the aromatic nature of the wood keeping away insects. The Italian chests "are generally decorated with surface designs etched with a pen on the absorbent grain of the wood, the ground being slightly cut out and worked over with punches shaped like nail-heads, stars, &c."

CYPRIPEDIN. Dried and powdered extract of the root of *Cypripedium pubescens,* or lady's-slipper. It is used in nervous affections, hysteria, hypochondriasis, and epilepsy.—*Dose,* 1 to 3 gr. in pill.

CYSTICERCI. These parasites are embryo tænia or tapeworm, infesting the bodies of men and different animals. One variety of the *Cysticerci* has its habitat in the organisms of men, pigs, oxen, horses, camels, sheep, and roe-deer; another in the muscles and internal organs of cattle; a third is found in cattle, sheep, horses, the reindeer, squirrels, certain kinds of monkeys, and occasionally in man; whilst a fourth—the *Cysticercus cellulosæ*—is more especially met with in measly pork. Professor Gamgee believes that probably 5% of the pigs in Ireland are affected with this last *Cysticercus.*

Professor Leuckart seems to have shown pretty conclusively that man may become infested with a certain form of tapeworm by partaking of imperfectly cooked veal or beef, infested with the second variety of the parasite. See TAPEWORM.

CYST'INE. $C_3NH_7SO_2$. *Syn.* CYST'IC OXIDE. Obtained from cystic oxide calculi (in powder) by digestion in solution of ammonia. By spontaneous evaporation the ammoniacal solution deposits small, colourless crystals of cystic oxide. It forms a saline compound with hydrochloric acid, and is decomposed by the strong alkalies.

CY'TISINE. A purgative bitter principle extracted from the *Cytisus laburnum,* Linn., or *common laburnum,* and some other plants.

DAGUERRE'OTYPE. See PHOTOGRAPHY.

DA''HLIA DYE (dāle'-y'ă). The shade of colour which is commonly termed 'dahlia' is a reddish lilac. It is produced by combining a blue or purple with red when a compound colour is used. Upon wool and silk it can be obtained directly by means of archil or cudbear, either alone or 'blued' by a small quantity of sulphate of indigo. Upon cotton indifferent shades of dahlia are obtained by macerating in sumac liquor, working in tin solution, and dyeing in logwood mixed with some red wood.

DA''HLINE. A species of fecula obtained from the tubers of the dahlia. It is identical with inuline, q. v. It is not employed in the arts.

DAIR'Y. The place where milk is kept and cheese and butter made. The best situation for a dairy is on the north side of the dwelling-house, in order that it may be sheltered from the sun during the heat of the day. Ample means should be provided to ensure ventilation, and at the same time to exclude flies and other insects. The temperature should be as equable as possible, ranging from 45°—55° F. To lessen the influence of external variations of temperature, the walls should be double, or of considerable thickness, and the windows provided with shutters or doors. In summer the heat may be lessened by sprinkling water on the floor, which will produce considerable cold by its evaporation. Dairies built of mud or 'cob' are preferred in the West of England; and this preference arises from the uniform temperature they maintain, on account of the great thickness of the walls, and their being very bad conductors of heat. In large dairy-farms, where butter and cheese are made, the dairy is generally a separate building, and divided into 3 or 4 apartments; one of which is called the 'milk-room;' a second the 'churning-room;' a third the 'cheese-room,' containing the cheese-press, &c.; and a fourth the 'drying-room,' where the cheeses are placed to dry and harden. To these must be added a scullery, furnished with boiler, water, &c., for scalding and cleaning the dairy utensils.

Cleanliness is very essential in all the operations of the dairy, and in none more so than in the milking of the cows. The hands and arms of the milkmaid should be kept scrupulously clean, and should be well washed with soap and water after touching the udder of a sick cow, as without this precaution the sores may be conveyed to the healthy ones. The milk-cans should be scalded out daily, and, as well as all the other dairy utensils, should be kept clean and dry. Before placing the milk on the shelves of the dairy it should be strained through a hair sieve or a searce covered with clean cheese-cloth, as by this precaution any stray hairs that may have fallen into the milk-pail will be taken out.

The average produce of a milch cow, supplied with good pasturage, is about 3 galls. daily from Lady Day to Michaelmas, and from that time to February about 1 gall. daily. Cows of good breed will be profitable milkers to 14 or 15 years of age, if well fed. See BUTTER, CHEESE, CREAM, MILK, &c.

D'ALBESPYRE'S BLISTERING TISSUE. Lard and ship's pitch, of each, 1 part; resina flav. and yellow wax, of each, 4 parts; finely powdered cantharides, 6 parts; melted together, and spread over taffety.

DAMAS'CUS BLADES. See STEEL.

DAMENPULVER—Ladies' Powder. (*J. Pohlmann,* Vienna.) A face-powder composed of 14 parts white-lead, 7 of talc, 1 of magnesia, coloured with carmine and perfumed with volatile oil. Very objectionable on account of the lead it contains.

DAMIANA. The leaves of *Turnera aphrodisiaca.* They are recommended as possessing tonic and aphrodisiac properties. Useful in sexual debility, paraplegia, and hemiplegia. A liquid extract is employed, 2 dr. representing 1 dr. of the leaf.—*Dose,* 1 to 2 dr.

DAMMAR. Cowdi or kauri resin. Afforded by *Dammara australis,* Lamb., the New Zealand cowdi pine; used in varnish-making. The largest masses are found buried in the soil, in many places far from where the trees now grow.

It is said that amber (?) mouthpieces for pipes, &c., are frequently made from fine fossil specimens of this resin, and are very difficult to distinguish from the real article.

The black dammar of Southern India is the produce of a tall tree, *Canarium strictum*, Roxb. *C. bengalense*, Roxb., yields a gum used for incense.

Dammar is also employed in mounting many microscopic objects, such as teeth, hair, hard bone, and most tissues which have been previously hardened by treatment with alcohol and chromic acid. Dammar is prepared for use as follows:

a. Gum dammar, $\frac{1}{2}$ oz.; oil turpentine, 1 oz.; dissolve and filter.

b. Gum mastic, $\frac{1}{2}$ oz.; chloroform, 2 oz.; dissolve and filter. Add solution *a* to solution *b* (*Dr Klein*).

If allowed to become thick by drying, dammar may be used as luting.

A disadvantage attaches to the use of dammar for mounting certain tissues in that it contracts in drying to such an extent as to crush and break up the specimens. Canada balsam is preferable.

DAMP, under any form, should be avoided. A humid atmosphere or situation is one of the commonest causes of agues, asthmas, rheumatism, and numerous other diseases.

Damp Linen is very injurious, and should be especially avoided. In travelling, when it is expected that the bed has not been properly aired, a good plan is to sleep between the blankets. To ascertain this point the bed may be warmed, and a cold, dry glass tumbler immediately afterwards introduced between the sheets in an inverted position. After it has remained a few seconds it should be examined, when, if it is found dry and undimmed by steam, it may be fairly presumed that the bed is well aired; but if the reverse should be the case, it should be avoided. When it is impossible to prevent the use of damp linen as articles of dress, the best way to obviate any ill effects is to keep constantly in motion and avoid remaining near the fire, or in a warm apartment, or in a draught of cold air until sufficient time has elapsed to allow of the escape of the moisture. The effect of evaporation is the reduction of the temperature of the body; hence the depressing action of damp linen.

Damp Walls render rooms very unwholesome, and where they exist the room should not be used as a living or sleeping apartment. The cure should be radical, and structural defects looked to, *e.g.* absence of a proper dry course, bad bricks and mortar, &c. Inner canvas and waterproof paper linings are mere palliatives, and do not remove the danger to health.

Ivy planted against the sound wall of a house is said to exclude dampness. If a wall is already damp, ivy planted against it will, when grown up, cause it to become dry, provided the brickwork is sound and the dampness does not arise from moisture attracted upwards from the foundation. Sometimes when ivy is propagated from flowering branches, it will not adhere to a wall at all; the way to get over this difficulty is to cut it back to near the surface of the ground. The young wood which will then form will take hold and cling immediately to almost anything. As a general rule, creepers, trained against the walls of a house, tend to retain damp rather than repel it.

The following is said to be a good application for damp walls: Dissolve $\frac{3}{4}$ lb. of mottled soap in 1 gall. of water. This composition is to be laid over the brickwork steadily and carefully with a large thick brush, but not in such a manner as to form a froth or lather on the surface. It must be allowed 24 hours to dry on the walls. Now mix $\frac{1}{2}$ lb. alum with 4 galls. water; let it stand 24 hours, and then apply it over the coating of soap. The operation must be performed in dry weather.

DAM'SON. A species of small black plum, much used in the preparation of tarts, &c. Damsons are rather apt to disagree with delicate stomachs, and also to affect the bowels. See PLUM.

DANDELION. *Syn.* PISSABED; TARAX'ACUM (Ph. L. E. and D.), L. A common British plant of the Nat. Ord. COMPOSITÆ. It is known among botanists by the names *Taraxacum officinale*, *T. dens-leonis*, and *Leontodon taraxacum*, Linn. Its root (*Taraxaci radix*, B. P.) is employed in medicine, being diuretic and tonic. It is roasted and used as coffee, and when mixed with an equal weight of foreign coffee constitutes the article once so much puffed under the name of 'dandelion coffee.' A similar mixture prepared with chocolate forms the 'dandelion chocolate' of the shops. The blanched leaves are used in salads, and the inspissated juice, extract and decoction are employed in medicine, and are considered laxative, tonic, diuretic, to stimulate the liver and increase its activity. Ground roasted dandelion root cannot now be sold under the name of 'dandelion coffee,' or mixed with coffee unless it has previously paid the chicory duty. See DECOCTION, EXTRACT, &c.

DANDRIFF. A disease of the scalp, characterised by constant desquamation of the epithelium in the form of the small troublesome particles known as scurf. A serviceable application is 2 dr. of borax dissolved in a pint of camphor water; the head to be washed with this lotion once or twice a week; or much benefit may also be derived by washing the head with tepid water, agitated with a piece of quillar bark until a strong lather is produced; or with water containing salt of tartar, in the proportion of 2 dr. of the salt to a pint of tepid water. As a general rule, the use of soap is to be discountenanced. See PITYRIASIS.

DAN'IELL'S BATTERY. See VOLTAIC ELECTRICITY.

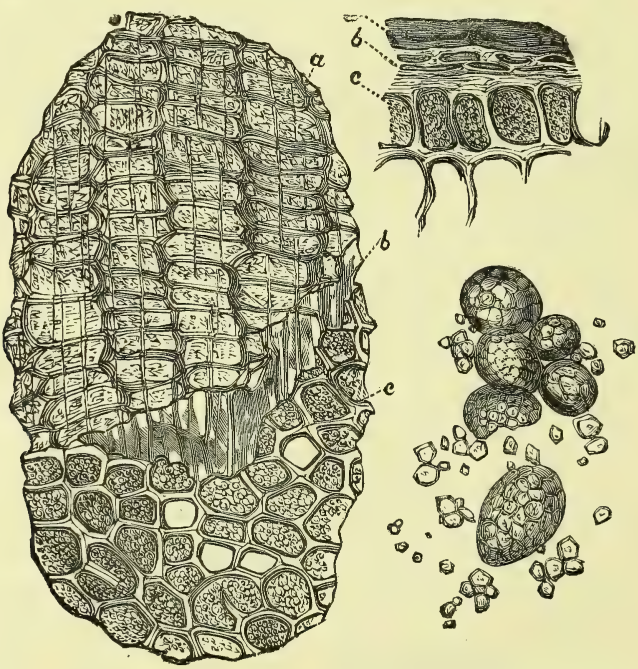
DAPHNE MEZEREUM or MEZEREON, Linn. A slender straggling shrub, found in some parts of Britain, and distributed throughout the subalpine districts of Europe. The bark, which is very acrid, is used in *medicine*, and for this purpose is imported chiefly from Germany; the barks of the SPURGE LAUREL (*Daphne laureola*, Linn.) and SPURGE FLAX (*D. gnidium*, Linn.) are used medicinally for the same purposes as *D. mezereum*.

DAPHNE PAPYRACEA, Wall. A tall Indian shrub. Paper is manufactured from the fibrous bark in India. Daphne paper is in common use in Northern India. It is extremely strong and

durable. The finer qualities are well suited for engravings.

DAPH'NIN. A peculiar bitter principle, discovered by Vauquelin in the *Daphne mezereum,* or mezereon. It is procured by separating the resin from the alcoholic tincture of the bark by evaporation; afterwards diluting the residue with water, filtering, and adding acetate of lead. A yellow substance falls down, which, when decomposed by sulphuretted hydrogen, yields daphnin, under the form of small, colourless, transparent, radiated needles. It is bitter; volatile; sparingly soluble in cold water; freely soluble in hot water, and in alcohol and ether. It possesses basic properties. See MEZEREON.

DARNEL. The powder of the seed of the *Lolium temulentum,* a poisonous grass, is not unfrequently found mixed with the flour of wheat, oats, and other cereals, and when these latter, under these circumstances, are partaken of as food, they give rise to more or less alarming symptoms of poisoning, which are thus enumerated by Dr Pereira:—Headache, giddiness, languor, ringing in the ears, confusion of sight, dilated pupil, delirium, heaviness, somnolency, trembling convulsions, paralysis, and great gastro-intestinal irritation. One of the most specific signs of poisoning by darnel seeds is said by Seeger to be the trembling of the whole body. Dr Taylor mentions a case in which 30 persons who had partaken of bread containing darnel seeds were violently attacked with the above symptoms; and another case is on record of 60 persons in a prison at Cologne being similarly attacked from the same cause. Hassall states that the flour of the darnel seed presents the following appearance under the microscope:—"The starch corpuscles are polygonal, and resemble in this respect those of rice. They are, however, much smaller, and frequently united into compound grains of various sizes, the larger grains consisting of some 50 or 60 starch corpuscles." The structure of the testa is very different from that of either rice or oat, or indeed any of the other cereal grains. It is formed of 3 coats or membranes. The cells of the coat form but a single layer, and, contrary to the arrangement which exists in the oat, their long axes are disposed transversely, in which respect they resemble rice. The fibres of the husk of rice and the cells of the testa of *Lolium* are, however, very distinct in other respects. In the former the cells are long and narrow, forming fibres, while in the latter they are but 2 or 3 times as broad.



The cells of the second coat, which are ranged in 2 layers, follow a vertical disposition, an arrangement which is contrary to that which obtains in all the other cereal grains with the exception of rice. The cells of the third coat form but a single layer, and resemble those of other grains.

DATE, DESERT. See BALANITES.

DATES, TREBIZONDE. The fruit of *Elæagnus orientalis,* L.fil. Used in the East as dessert and for making sherbet.

DATTOCK (*Detarium senegalense,* Gmelin). From the Gambia.

DATU'RA. *Syn.* THORN-APPLE; STRAMO'NIUM (Ph. L. E. & D.), L. A genus of plants belonging to the nightshade order, or ATROPACEÆ. The species *Datura stramonium* is an important medicinal plant, the leaves and seeds being offi-

cinal in B. P. It is anodyne and sedative, but not hypnotic, though it will often induce sleep by relieving pain. It affects the constitution in much the same way as belladonna.—*Dose,* 1 to 4 or 5 gr., in asthma, gout, headache, neuralgic and rheumatic pains, &c. In spasmodic asthma smoking the leaf often gives instantaneous relief, but must be exhibited with care, as the whole plant is intensely poisonous. A good plan is to make cigarettes of mild tobacco to which a small quantity of the dried leaves, rubbed to a powder between the hands, has been added. A violent catarrh will be greatly modified by smoking 1 or 2 such cigarettes. No antidote is known. Another species, namely, *Datura tatula,* is now preferred for cigars or cigarettes. Cigars are made from *Datura stramonium* more frequently than from *Datura tatula.* They are recommended for asthma. See ASTHMA, CIGARS (Stramonium), DATURIA (*below*).

DATU'RIA. *Syn.* DATU'RINE, DATURI'NA HYOSCY'AMINE. An organic alkali, discovered by Geiger and Hesse in *Datura stramonium,* or thorn-apple. It occurs also in *Hyoscyamus niger,* or henbane. It is best obtained from the seeds. Daturia dissolves in 280 parts of cold and 72 parts of boiling water; it is very soluble in alcohol, less so in ether. It tastes bitter, dilates the pupils strongly, and is very poisonous. It may be sublimed unaltered, and may be obtained in prismatic crystals by the addition of water to its alcoholic solution. With the acid it forms salts, which are mostly crystallisable.

DEAD, DISPOSAL OF. As every dead body during the process of the decomposition it undergoes gives rise to products that are not only in the highest degree offensive, but in an especial sense dangerous to the health and lives of a community, the disposal of the dead in a manner best calculated to ensure, with removal of the corpse from amongst the survivors, the least injurious consequences of its subsequent decay, becomes a problem of supreme importance to the sanitarian.

The Romans at one time burned but afterwards buried their dead. The popular notion that cremation was universal among the Romans is erroneous; the process was far too costly to be in general use, and, as a matter of fact, only the wealthy dead were burned. The slaves and domestics of a great man were buried around the tomb which contained his ashes and those of other members of his family. The Greeks practised cremation, the Egyptians embalmment (previously disembowelling the body), under the belief that after the lapse of many thousands of years the soul would return to its earthly mansion. The Hebrews sometimes burned their dead, and sometimes interred them. Amongst the ancient Hindoos the body was got rid of sometimes by cremation, sometimes by being cast into the Ganges or other sacred river, and sometimes by exposure, until eaten by vultures. The Ichthyophagi, or fish-eaters, appear to be the only people of antiquity who disposed of their dead by throwing them into the sea.

Amongst modern civilised nations interment is the method almost universally adopted for disposing of the dead.

Embalmment has been of late years occasionally practised in America, and was frequently adopted during the late civil war in many cases, since it afforded the means of sending the bodies of the slain to surviving relatives at long distances. Sir Henry Thompson's advocacy of cremation was the means of causing the establishment in England a few years back of a society for its introduction; but neither here nor in Germany, where it has occasionally been employed, has the practice been adopted save in a very few instances, most of which seem to have been merely experimental. In Calcutta cremation is still practised to some extent by the native population; the process being very effectively carried out by a French company, which has been established for some years. We may mention here an important modification of the ordinary form of interment proposed by Mr Sydney Hadden. Mr Hadden's proposal is to dispense with the coffin, and to place the corpse instead in a large wickerwork receptacle filled with flowers, then inter it. To this plan there is a very grave objection; inasmuch as the process of decay is *too* rapid, and a quantity of horrible liquid or semi-liquid matter is produced at a rate far beyond the capacity of the surrounding earth to destroy; the soil becomes clogged, and cannot perform its function of destroying and absorbing the animal remains.

Of the three modes of disposal of the dead, viz. by burial, by burning, and by consignment to the sea, the first, as we have already said, is the almost invariably prevalent custom amongst civilised communities. That from a sanitary point of view it is less to be commended than either of the other methods is, we think, not difficult of demonstration. When a body is burned the resulting gaseous products of combustion, which most probably consist mainly of carbonic acid, carbonic oxide, and nitrogen, diffuse harmlessly into the atmosphere, and there remains behind only the calcined bones which formed the skeleton. An experiment by Sir Henry Thompson has shown that cremation may be performed without giving rise to odour of any kind at a comparatively small expense, and within a very moderate space of time. He burned a body weighing 227 lbs. in fifty-five minutes by placing it in a cylindrical metallic vessel 7 feet long and 6 feet in diameter, previously heated to incandescence. The evolved gases were made to pass over a large surface of strongly heated fire-bricks, which formed part of the furnace in which the metallic vessel was placed. The furnace and its fittings were designed by Dr Siemens. The remaining ashes weighed about 5 lbs. In his pamphlet 'On Cremation,' Sir Henry Thompson has proposed that the custom, if adopted, should be carried out in the following manner: "When death occurs and the necessary certificate has been given, the body is placed in a light wood shell, then in a suitable outside receptacle preparatory to removal for religious rites or otherwise. After a proper time has elapsed it is conveyed to the spot where cremation is to be performed. There nothing more need be seen by the last attendant or attendants than the placing of a shell within a small compartment, and the closing of the door upon it. It slides down into the

heated chamber, and is left there an hour until the necessary changes have taken place. The ashes are then placed at the disposal of the attendants." Sir Henry suggests that, previous to the burning of any corpse, proper officers appointed for the purpose should examine into and certify as to the cause of death, and, if satisfied that it has resulted from natural causes, that they should give the certificate he alludes to.

Sir Henry Thompson proposes that the functions of the officers appointed for this purpose should be the same as those of the *médicins vérificateurs*, who are medical inspectors appointed by the municipality of Paris and the other large cities, whose duty consists in visiting each house where a death occurs, in assuring themselves that the person is really dead, and that there are no suspicious circumstances attending the demise.

In Paris alone there are more than eighty of such medical functionaries.

Burial by casting the corpse into the depths of the sea possesses the great advantage over ordinary interment of removing it from near the habitation of man, whilst the sea-water, by its antiseptic properties, would be as little favourable to the dissemination of noxious putrescent compounds as cremation is. On the contrary, if the dead are disposed of by the ordinary mode of burial, the objectionable effects arising from their decomposition in the earth are, under the most favourable conditions, only partially overcome; and the reason is obvious, since whilst deep-sea burial prevents animal decay altogether, and burning destroys the body, which, if not got rid of, would become putrid; burial in the earth permits its slow and lengthened decomposition to go on unchecked, and thus very frequently to become a source of contamination and danger to health. "After death the buried body returns to its elements, and gradually, and often by the means of other forms of life which prey on it, a large amount of it forms carbonic acid, ammonia, sulphuretted and carburetted hydrogen, nitrous and nitric acids, and various more complex gaseous products, many of which are very fetid, but which, however, are eventually all oxidised into the simpler combination. The non-volatile substances, the salts, become constituents of the soil, pass into plants, or are carried away into the water percolating through the ground. The hardest parts, the bones, remain in some soils for many centuries, and even for long periods retain a portion of their animal constituents" (*Parkes*).

The atmosphere in the vicinity of graveyards and cemeteries is notoriously unhealthy, whilst water taken from wells situated near them is often so impure as to be wholly unfit for drinking. Several instances are on record in which the disturbance of an old graveyard has frequently been the means of disseminating disease. But, although the disposal of the dead by means either of cremation or by consignment of the body to the deep caverns of the ocean are methods, from a hygienic point of view, immeasurably superior to earth-burial, there are, we think, certain obstacles to their adoption, even to a limited extent, by civilised communities, at any rate, for many years to come.

"Both cremation and deep-sea burial are open to the objection that should the proposed officers appointed to inquire into the circumstances attending death have been mistaken in their verdict, as for instance in overlooking or not suspecting a case of secret poisoning, not only would the murderer escape detection, but a sense of possible immunity from punishment might act as an encouragement to others who were equally guilty minded. The proposal that the stomach should be preserved and kept for a certain time, and, in case of suspicion justifying it, examination, would in many instances fail to lead to detection, since, if certain alkaloids had been employed, they would have to be searched for, not in the stomach, but in the tissues of the dead body. Again, an obstacle to the universal adoption of deep-sea burial would be, in the case of vast continents, the difficulty of transmission from their interior, of the corpse, to the shore. But even if these objections against cremation and sea-burial could be overcome (and possibly they may be eventually), there would still remain the invincible repugnance of the survivors to what sentiment and feeling will persist in regarding as cruel indignity and irreverence toward the dead.

"Yet the eventual disposal of our frames is the same in all cases; and it is probably a matter merely of custom which makes us think that there is a want of affection, or of care, if the bodies of the dead are not suffered to repose in the earth that bore them.

"In reality, neither affection nor religion can be outraged by any manner of disposal of the dead which is done with proper solemnity and respect to the earthly dwelling-place of our friends. The question should be placed entirely on sanitary grounds, and we shall then judge it rightly.

"What is the use of preserving for a few more years the remains which will be an object of indifference to future generations? The next logical step would be to enshrine these remains in some way so as to ensure their preservation, and we should return to the vast burial mounds of Egypt.

"At present the question is not an urgent one, but if peace continue and if the population of Europe increase, it will become so in another century or two.

"Already in this country we have seen, in our own time, a great change; the objectionable practice of interment under and round churches in towns has been given up, and the population is buried at a distance from their habitations. For the present that measure will probably suffice, but in a few years the question will again inevitably present itself" (*Parkes*).

Since, however, for the reasons above specified, earth-burial seems to be the only means of disposing of the dead likely to prevail for many years to come, the question arises as to how its attendant evils can be as much as possible minimised. The following suggestions, that may assist to effect this, are offered:—As quickly as possible after death the body should be covered with sawdust, to which carbolic acid has been added, a precaution which not only prevents the escape of fetid gases, but also of putrescent fluids from a badly jointed coffin. Charcoal,

although an excellent disinfectant, from its colour, could not out of consideration for the feelings of the relatives or friends be used until the coffin with its contents had been screwed down.

It is always desirable (save for some special reason) that the corpse should be interred within 3 or 4 days of the demise. If a body is kept above ground for some time, Mr Herbert Barker recommends a thin layer of sawdust and sulphate of zinc to be placed over it, in the proportion of 2 parts of the former to 1 of the latter. The coffin should be made of a material impervious to the air, and of such strength as to withstand the pressure of the overlying earth.

Mr Wynter Blyth, in his 'Dictionary of Hygiene,' recommends a coffin described by Mr Baker in his evidence before the sanitary commission. The body being first of all placed in a common shell, this shell is placed in a coffin; the interval between the two is filled with common pitch, and then the outside coffin is coated over with pitch; so that it is as perfectly air-tight as a leaden shell. If desired a glass can be placed so as to leave the face exposed to the view of a jury when necessary with regard to the interment.

"The advantages of deep over shallow burying are obvious. The greater the mass of superincumbent earth into which the gaseous products of decomposition diffuse, the better the chance of their absorption and removal by the soil, and the less risk of their consequent escape into the contiguous atmosphere, as well as of the danger of contamination to the water of wells, &c. The depth of the grave varies in different countries. In Austria it is 6 ft. 2 in.; in Hesse Darmstadt, from 5 ft. 7 in. to 6 ft. 6 in.; Munich, 6 ft. 7 in.; Stuttgard, 6 ft. 6 in.; Russia, from 6 ft. 10 in. In our country the practice is generally to make the depth about 6 ft., but then coffins may be placed one on the other, so that, as an actual fact, they often very closely approach the surface. The regulations followed at Stuttgard are much to be commended. In the cemeteries there the space allotted for each grave is an oblong piece of land 10 ft. in length, and 5 ft. broad. In France the graves vary in depth from 1¼ metres (4·921 ft.) to 2 metres (6·561 ft.). They are 8 decimetres (2·264 ft.) in breadth, and distant the one from the other 3 to 4 decimetres (11·911 in. to 1·132 ft.)" (*Blyth*).

To render a cemetery therefore as little prejudicial as possible to a community, not alone should deep burial be enforced, but only one body should be permitted to be deposited in a grave, at least till after the lapse of some years. Some sanitary authorities recommend the use of quicklime or charcoal, advising them to be thrown into the grave previous to its being closed. Of the two, charcoal is the preferable disinfectant, although it does not entirely prevent putrefaction, nor the evolution of bad-smelling gases. No more efficient means of absorbing organic matters, and carbonic acid given off by the decaying corpse in the earth, can be devised than that of rapidly growing trees and shrubs in abundance around the graves.

For the funereal cypress and yew, which are slowly growing trees, why should a needless sentiment prevent the substitution of the much more sanitary and less sombre-looking eucalyptus in countries where this plant will flourish?

Old burial-grounds which have become offensive may be best disinfected by covering the ground with fresh earth to the depth of several inches, and by planting it with trees and sowing it with grass seed. Twenty-six city graveyards covering a superficial area of about 48,000 square yards, and in which, according to moderate calculation, there were not less than 48,000 tons of human remains, were successfully dealt with in this manner.

In the case of church vaults they should be first opened, a quantity of quicklime thrown into them, and thus freely exposed to the external air. The coffins should then be rearranged crossways like brick in a building, and filled in with dry earth or masons' rubbish, mixed with about 5% or 10% of vegetable charcoal. The vaults should next be ventilated by means of an upcast and downcast shaft of the size of a rain-water pipe, and the whole should then be closed in. In 1860, 250 vaults in 71 city churches were thus disinfected. These vaults contained the coffins and remains of at least 11,000 dead bodies, which, previous to the adoption of the above measures, were very offensive (*Letheby*). When bodies are removed from the vaults to other places, Dr Letheby recommends them to be in closed coffins and in cases containing an abundant supply of carbonate of lime powder.

The disposal of the dead frequently becomes a matter of considerable difficulty in time of war or during a siege. Under these circumstances cremation may be found the most desirable method of getting rid of them. If the bodies are buried they should always be at as great a distance as possible from one another, and as deep as they can be. If procurable, charcoal should be thrown over them; if it cannot be obtained, sawdust and sulphate of zinc, or carbolic acid, may be employed. Quicklime is also commonly used, but it is less useful.

At Metz, in 1870, the following plan was adopted:—A pit of about 17 feet in depth was filled with dead disposed of as follows:—A row of bodies was laid side by side; above this a second row was placed, with the heads laid against the feet of the first row; the third row were placed across, and the fourth row in the same way, but the heads to the feet of the former; the fifth row was placed as No. 1, and so on.

Between each layer of bodies about an inch of lime, in powder, was placed. From 90 to 100 bodies were thus arranged on a length of 6½ feet, and reached to about 6 feet from the surface; the pit was then filled up with earth, and though 8400 bodies were placed in that pit there were no perceptible emanations at any time.

Around Metz the graves of men, horses, and cattle were disinfected with lime, charcoal, and sulphate of iron. Immense exertions were made to clean and disinfect the camps and battle-fields, and in the month of May, 1871, from 1200 to 1600 labourers were employed by the Germans. Wherever practicable the ground was sown with oats or barley or grass. The hillocks formed by the graves were planted with trees.

In many cases at Metz bodies were dug up by the Germans when there was any fear of water-courses being contaminated, or if houses were near. On account of the danger to the workmen, graves containing more than 6 bodies were left untouched, and the work was always done under the immediate superintendence of a physician. The earth was removed carefully, but not far enough to uncover the corpse; then one end of the corpse was uncovered, and as soon as the uniform or parts of the body were seen, chloride of lime and sawdust, or charcoal and carbolic acid, put in; the whole earth round the body was thus treated, and the body at length laid bare, lifted and carried away. The second body was then treated in the same way.

Near Sedan, where there were many bodies very superficially buried, burning was had recourse to. Straw mixed with pitch was put into the graves, and was lighted; 1 ton of pitch sufficed for from 15 to 20 bodies. Opinions as to this practice were divided, and it is not certain how many graves were thus dealt with. It seems probable that only the surface of the body was burnt, and when many bodies were together in the grave, some were not touched at all. On the whole the experiment appears to have been unsuccessful.

The Belgian experience at Sedan was in favour of employing chloride of lime, nitric acid, sulphate of iron, and chlorine gas. Carbolic acid did not answer so well. The sulphate of zinc and charcoal, which Barker found so useful, was not tried (*Parkes*).

Various statutes have been framed for the burial of the dead and for the management and selection of the burial-grounds. In the carrying out of these enactments the local authorities have only an indirect voice, exception being made in the case of a local government district in which the vestry determines to appoint a burial board. The vestry then has power to constitute the local board so appointed the burial board of such district or parish, and to rule that the expenses of such burial board shall be met by a rate levied on such parish, after the manner of a general district rate.

Vict. 21 and 22, c. 90, s. 49, enacts that if such parish has been declared a ward for the election of members of the local board, such members are to form the burial board for the parish.

By Vict. 24 and 25, c. 61, s. 21, it is enacted that a sanitary authority may provide a proper place for the reception of dead bodies, as well as for those which are to be subjected to a post-mortem examination.

A sanitary authority is also empowered to make arrangements for interment. Any urban sanitary authority has the power of regulating these matters by by-laws. When once constituted a burial board, a sanitary authority has to see to the carrying out of the Burial Acts, to repair the fences of disused burial-grounds, and generally to keep in proper order and regulate all burial-grounds within its jurisdiction.

The law enacts that the proper sanitary authority shall close any burial-ground which is detrimental to the health of those living in its neighbourhood, or of persons frequenting any church; and throws upon such sanitary body the duty of providing a proper place of interment elsewhere.

It may be well to know that by common law it is incumbent upon any person under whose roof a death has taken place to provide the corpse with interment. Such person may neither cast the body forth, nor carry it uncovered to the grave, but he must give it decent burial. This obligation is imposed upon public bodies as well as on private persons.

Upon presentation of a certificate signed by a properly qualified medical practitioner, a justice of the peace may order, under certain circumstances, the removal of the dead body to a mortuary.

Interment within the walls or underneath the pavement or floor of any church, or other place of public worship, built in any urban district, has since August 31st, 1848, been interdicted under a penalty of £50.

DEAF'NESS. An imperfection or absence of the sense of hearing. When deafness is present in infancy and childhood, it is accompanied with dumbness, or imperfect articulation, in consequence of the impossibility of conveying a knowledge of the sounds necessary for the exercise of the imitative faculty of speech. Deafness frequently arises from some imperfection or obstruction of the passage leading to the membrane of the tympanum or drum of the ear. In some cases this passage is totally closed by a membrane, or some malformation of the tube, which may frequently be removed by a surgical operation. Even instances of partial obliteration of this passage have occurred, which have been successfully treated. Enlarged tonsils are a very common cause of deafness; and when such is the case, their excision will generally effect a cure. It should be remembered that the ear is a delicate organ and should not be tampered with by unskilled persons; the removal of a bead or other foreign body requires to be effected with great care, or permanent injury to hearing may result. Another cause of deafness is the presence of foreign bodies in the aural passages or the accumulation of hardened wax. In these cases the best treatment is to inject warm water into the ear by means of a proper syringe. When deafness arises from imperfection of, or injury to the tympanum or drum of the ear, the effects of the application of the artificial membrana tympani invented by Mr Yearsley (moistened cotton-wool) are generally immediate and truly wonderful. By its aid persons previously so deaf as to be incapable of bearing their share in conversation have been enabled to hear an ordinary whisper. Insects may be destroyed by pouring a spoonful of warm olive oil, or camphorated oil, into the ear overnight, retaining it there until the next morning by means of a piece of cotton-wool, when it may be washed out with a little mild soap and warm water. When there is a deficiency of the natural secretion of wax, or a dryness of the aural passage, mild oleaginous stimulants may be employed. For this purpose a little olive oil, almond oil, to which a few drops of oil of turpentine, oil of juniper, or camphor liniment

have been added, may be used with advantage. A piece of cotton-wool, moistened with glycerine, is an excellent application in such cases. When deafness is accompanied with continued acute pain, or a discharge of purulent matter, inflammation of the tympanum or some other portion of the internal ear probably exists, and medical advice should be sought as soon as possible. The deafness that frequently accompanies a violent cold is generally caused by obstructions in the Eustachian tubes, and goes off as soon as the secretions return to a healthy state. In some forms of deafness blisters behind the ears are useful. A clove of garlic wrapped in cotton or gauze, or a few drops of the juice introduced into the ear, is extremely efficacious in nervous deafness. When imperfect hearing depends upon disease of the auditory nerve, or an extensive obliteration or malformation of the internal ear, it scarcely admits of cure.

DEATH, SIGNS OF. It is often by no means easy to determine whether life be extinct or no.

Cessation of the heart's beat is a certain sign, but may require prolonged and careful examination with the stethoscope before a decision can be arrived at.

Magnus recommends tying a piece of string round a finger or toe, and observing whether the extremity after a time becomes livid and swollen as it would in health.

Cessation of Respiration. The methods of holding a mirror to the nostrils and observing whether moisture condenses on it, or placing a cup of water on the chest and observing whether the reflections in its surface change their position, are useful and practical. Mere coldness of the body is a bad guide. *Rigor mortis*, or stiffening of the body due to coagulation of the muscle plasma, is proof of death, as is also, of course, putrefaction.

DEBILITY may be constitutional and inherited, but generally develops after birth, and commonly as the result of defective nutrition. Debility of special parts or organs may result from innumerable causes, and the treatment in all cases will vary with the nature and origin of the disease.

DECANTATION. The operation of removing the clear portion of a liquid from the admixed solid matter which has been allowed to subside. This is done by gently inclining the vessel and pouring off the clear solution, or on the large scale by means of a siphon or pump. This process is often used in the laboratory for the purification of somewhat densely aggregated precipitates, which subside readily. The precipitate is allowed to settle, and the supernatant fluid poured off through a filter; water is then added, and shaken up with the precipitate; the latter is again allowed to subside, and the water poured off. This process is repeated till the precipitate has been washed quite free from soluble impurities.

DECANT'ERS. There is often much difficulty experienced in cleaning decanters, especially after port wine has stood in them for some time. The best way is to wash them out with a little pearl-ash and warm water, adding a spoonful or two of fresh-slaked lime if necessary. To facilitate the action of the fluid against the sides of the glass, a few small cinders or pieces of raw potato may be used. A spoonful of strong oil of vitriol will also rapidly remove any kind of dirt from glass bottles. Decanters which have become furred by holding hard water may be cleaned with a spoonful of hydrochloric acid ('spirits of salt') diluted with 3 or 4 times its weight of water. See Stoppers.

DECARBONISA'TION. This operation is performed on cast iron, to convert it into soft iron. The articles to be decarbonised are packed in finely powdered hæmatite or native oxide of iron, to which iron filings are often added, and exposed for some time to a strong red heat, by which the excess of carbon is abstracted or burnt out. The process somewhat resembles annealing or cementation.

DECAY. See Eremacausis.

DEC'IMALS. *Syn.* Decimal fractions. Fractions which have for their denominator 10, or some power of 10; as 100, 1000, &c.; the number of ciphers in the denominator being always equal to the number of figures in the numerator. Thus, ·2, ·25, ·125, respectively represent $\frac{2}{10}$, $\frac{25}{100}$, $\frac{125}{1000}$. The denominator of decimals is never written, the dot placed before the first figure of the numerator expressing its value. Ciphers placed on the right hand of a decimal fraction do not alter its value; for ·5, ·50, ·500, are each equal to $\frac{1}{2}$: but ciphers placed on the left hand of a decimal diminish its value in a tenfold proportion; thus, ·3, ·03, ·003, respectively answer to the common fractions $\frac{3}{10}$, $\frac{3}{100}$, and $\frac{3}{1000}$. Every figure on the left-hand side of the dot or decimal sign is a whole number.

Addition and subtraction of decimals are performed in the same manner as with common numbers, care being taken to place the numbers under each other according to their several values; as, tens under tens, hundreds under hundreds, &c.

Multiplication of decimals is performed in precisely the same manner as with whole numbers, merely pointing off as many figures in the product as there are decimals in the multiplier and multiplicand put together.

Division of decimals. As the last, but pointing off as many figures in the quotient as the decimal places in the dividend exceed those of the divisor. If there are not figures enough in the quotient, the deficiency must be supplied by prefixing left-hand ciphers. Ciphers are also added to the right hand of the dividend, or to a remainder, when there are more figures in the divisor than in the dividend, by which the quotient may be carried on to any extent.

A vulgar fraction is reduced to a decimal by dividing the numerator (increased sufficiently with ciphers) by the denominator. Thus, $\frac{1}{2}$ = ·5, $\frac{1}{8}$ = ·125, &c.

The constant use of decimals in the laboratory, in the surveys of the Excise, and in numerous chemical calculations, induces us to press the subject on the attention of operatives and others of neglected education. An attentive perusal of the above, and a few hours' application, will make the matter familiar to them.

The value of a decimal of any denomination is found by multiplying it by the number of parts in the next less denomination, and cutting off as

many places to the right hand as there are decimals, and so on until the terms are exhausted. Thus, ·634 oz. is =

$$\begin{array}{r} \cdot 634 \\ 8 \\ \hline 5\cdot 072 \text{ dr.} \\ 60 \\ \hline 304\cdot 320 \text{ gr.} \end{array}$$

or 5 dr. $4\frac{1}{3}$ gr. (nearly).

DECOC′TION. *Syn.* DECOCT′UM, L. An aqueous solution of the active principles of any substance obtained by boiling; also the process of preparing such solutions.

The effect of decoction in water differs greatly from that of infusion. At the temperature of 212° F., the essential oils and aromatic principles of vegetables are dissipated or decomposed; while by infusion in hot water, in covered vessels, they remain for the most part uninjured. The solvent powers of boiling water are, however, much greater than those of hot water; and many vegetable principles scarcely acted on by the one are freely soluble in the other. This is the case with many of the alkaloids, on which the medicinal virtues of several vegetables depend. On the other hand, the solutions of many substances, though more readily made by boiling, are speedily weakened or rendered inert by ebullition, in consequence of the active principles being either volatilised along with the steam or oxidised or decomposed by exposure to the atmosphere. This is particularly the case with substances abounding in extractive or astringent matter. When the medicinal properties of vegetables are volatile, or are injured by a strong heat, infusion should be had recourse to, in preference to boiling; but when a solution of the fixed constituents is alone sought, decoction is preferable.

The substances employed for making decoctions should be well bruised, or reduced to a coarse powder, or, if fresh and soft, they should be sliced small. The vessel in which the ebullition is conducted should be furnished with an accurately fitting cover, the better to exclude the air; and the application of the heat should be so conducted that the fluid may be kept simmering or only gently boiling, as violent boiling is not only quite unnecessary, but absolutely injurious to the quality of the product. In every case the liquor should be strained whilst hot, but not boiling, and the best method of doing this is to employ a fine hair sieve or a coarse flannel bag. In general it is found that, as decoctions cool, a sediment is formed in consequence of the boiling water dissolving a larger portion of vegetable matter than it can retain in solution when cold. This deposit for the most part consists of the active principles of the solution, and, unless when otherwise ordered, should be mingled with the clear liquid by agitation when the decoction enters into extemporaneous compositions, or when the dose is taken.

The length of time occupied by the ebullition is another point demanding some attention. Long boiling is in no case necessary, and should be avoided, especially in decoctions prepared from aromatic vegetables, or those abounding in extractive. The Colleges, in such cases, direct the ingredients 'to be boiled for a short time,' or 'for ten minutes;' or they limit the period of the ebullition by stating the quantity that must be volatilised, as—'boil to a pint and strain.' The last method is generally employed for those substances that do not suffer by lengthened boiling.

In preparing compound decoctions those ingredients should be boiled first which least readily give up their active principles to the menstruum, and those which most readily part with them should be added afterwards. In many cases it is proper simply to infuse the more aromatic substances in the hot decoction of the other ingredients, by which means their volatile principles will be better preserved.

Distilled water, or perfectly clean rain water, should alone be used for decoctions, extracts, and infusions. Spring and river water, from containing lime, have much less solvent effect.

The aqueous solutions of organic matter, from the nature of their constituents, rapidly ferment or putrefy at the ordinary temperature of the atmosphere. Neither decoctions nor infusions are fit to be used in dispensing unless made the same day. They should, consequently, be only prepared in small quantities at a time, and any unconsumed portion should be rejected, as it would be imprudent for the dispenser to risk his own reputation and the welfare of the patient by employing an article of dubious quality.

It has of late years become a general practice for the wholesale houses to vend preparations under the name of 'Concentrated Decoctions,' which, with the exception of the compound decoction of aloes, are stated to be of eight times the pharmacopœial strength; so that 1 dr. of these liquids added to 7 dr. of water forms extemporaneous decoctions, professedly resembling those of the pharmacopœia. The decoction of aloes is made of only four times the usual strength, as the nature of its composition would not permit of further concentration. Such preparations are, however, very imperfect substitutes for the freshly made decoctions. The extreme difficulty of forming concentrated solutions of vegetable matter with bulky ingredients too often leads to the omission of a portion of the materials, or to the practice of concentrating the liquid by long evaporation. In the first case the strength is, of course, less than it should be; and in the second the quality is injured, and, perhaps, the preparation is rendered nearly inert by the lengthened exposure to heat, and the consequent volatilisation or decomposition of its active constituents. The common practice of adding a considerable portion of spirit to these preparations, which is absolutely necessary to preserve them, is also objectionable, as, in many of the cases in which decoctions are prescribed, this article, even in small quantities, exerts a prejudicial action. Some concentrated decoctions have been recently offered for sale which do not contain alcohol, being preserved by the addition of sulphurous acid or sulphite of lime.

Decoction of Alconorque. *Syn.* DECOCTUM ALCONORCO. American alconorque bark, ½ oz.;

water, 16 oz.; boil to 8 oz., and strain.—*Dose*, 1 oz. two or three times a day, in phthisis.

Decoction of Alder. *Syn.* DECOCTUM ALNI. Bark of common alder, 1 oz.; water, 20 oz.; boil to 16 oz.

Decoction of Alder, Black. *Syn.* DECOCTUM RHAMNI FRANGULÆ. Black alder bark, dried, 1 oz.; water, $1\frac{1}{2}$ pints; boil to 1 pint and strain.

Decoction of Al′oes. *Syn.* COMPOUND D. OF A., BALSAM OF LIFE; BAUME DE VIE, Fr.; DECOCTUM AL′OËS (Ph. E.), D. A. COMPOS′ITUM (B. P. and Ph. D.), L. *Prep.* 1. (B. P.). Extract of liquorice, 1 oz.; extract of socotrine aloes, 2 dr.; powdered myrrh and saffron, of each, $1\frac{1}{2}$ dr.; carbonate of potassa, 1 dr.; tincture of cardamoms, 8 oz.; water, a sufficiency. Coarsely powder the extract of aloes and myrrh, and put them, together with the carbonate of potash and extract of liquorice, into a covered vessel, with a pint of distilled water; boil gently for five minutes, then add the saffron; let the vessel with contents cool, then add the tincture of cardamoms, and, covering the vessels closely, allow the ingredients to macerate two hours, finally strain through flannel, pouring as much distilled water over the contents of the strainer as will make the product measure 30 oz.

2. (Ph. E.) Aloes, myrrh, and saffron, of each, 1 dr.; extract of liquorice, $\frac{1}{2}$ oz.; carbonate of potassa, 40 gr.; water, 16 fl. oz.; boil to 12 fl. oz.; strain and add compound of tincture of cardamoms, 4 fl. oz.

3. (Ph. D.) As No. 1 (nearly), but using hepatic aloes.

A warm cathartic.—*Dose*, $\frac{1}{2}$ to $1\frac{1}{2}$ oz.; in habitual costiveness, dyspepsia, jaundice, &c.

Obs. By boiling the saffron as ordered by the Dublin and Edinburgh Colleges, nearly the whole of its fragrance is dissipated. A better plan is to macerate it in the tincture for a few days, previously to adding the latter to the decoction of the other ingredients. After the tincture has been strained off from the saffron, the latter may be washed with a little water, to remove any adhering colour and odour, and this may be added to the decoction. The addition of the tincture produces a deposit of mucilaginous and feculent matter, which has been dissolved out of the liquorice, for which reason some houses omit the latter altogether, and supply its place with an equal quantity of sugar or treacle, and a little colouring. By this method the liquid, after being once obtained clear, will continue so for any length of time.

4. (Wholesale.) Solazzi juice, $1\frac{1}{2}$ lbs.; kali (carbonate of potassa), 4 oz.; hepatic aloes, $5\frac{1}{2}$ oz.; myrrh (small), 5 oz.; water, $4\frac{1}{2}$ galls.; boil to 3 galls., strain through flannel, cool, and add, of compound tincture of cardamoms, 10 pints; previously digested for 10 days on saffron, $2\frac{1}{2}$ oz.; mix well, and add essential oil of nutmeg, 15 drops; oils of cassia and carraway, of each, 10 drops; and oils of cloves and pimento, of each, 5 drops; in a week decant the clear portion from the sediment, and preserve it in a cool place.

5. (Concentrated; D. A. CONCENTRA′TUM, L.) *a.* Lump sugar, 8 oz.; colouring, $\frac{1}{4}$ pint; carbonate of potash, 2 oz.; aloes, $3\frac{1}{2}$ oz.; myrrh and saffron, of each, $2\frac{1}{2}$ oz.; compound tincture of cardamoms, $\frac{1}{2}$ gall.; water, 3 pints; boil the first five in the water, until reduced to nearly one half; cool, and add the tincture, previously digested for a week, on the saffron; and proceed as above. 14 oz. of extract of liquorice may be used instead of the sugar and colouring.

b. Aloes, myrrh, liquorice, and potassa (all in powder), and saffron as last; compound tincture of cardamoms, $5\frac{3}{4}$ pints; digest a fortnight, and filter. In this way a very odorous and beautiful preparation is produced, which has been much admired. The above are said to possess four times the strength of the College preparation.

Decoction, Anticol′ic. *Syn.* ANTICOLIC AP′OZEM, DEGLAND'S COLIC MIXTURE; APOZ′EMA ANTICOL′ICUM, L. *Prep.* Senna leaves, 2 oz.; boiling water, 1 pint; simmer gently to 16 fl. oz.; press out the liquor, add sulphate of soda, 1 oz.; syrup of buckthorn, 2 oz.; and strain through flannel. Used by glassfuls in lead colic, or after poisoning by lead.

Decoction, Antidar′trous. Decoction of Bitter Sweet (see *below*).

Decoction of Apocynum. *Syn.* DECOCTUM APOCYNI. Root of *Apocynum cannabinum*, 1 oz.; juniper berries, 1 oz.; water, 3 pints. Boil to 2 pints. A wine-glassful frequently. In dropsy.

Decoction of Ar′nica. *Syn.* DECOCTUM ARNICÆ, L. *Prep.* 1. (*Swediaur.*) Flowers of *Arnica montana*, 1 oz.; water, 3 pints; boil to a quart; filter, and add of syrup of ginger, 3 oz.—*Dose*, 1 to 2 fl. oz. every 2 or 3 hours; in aphonia, paralysis of the voluntary muscles, rheumatism, &c.; and as a substitute for bark in putrid fever, agues, &c.

2. (Ph. Cast. Aust., 1841.) Arnica root, 2 dr.; water, 9 oz.; boil to 6 oz. and strain.—*Dose*, 1 oz.; as the last.

Decoction of Asparagus. *Syn.* DECOCTUM ASPARAGI. Roots of asparagus, 1 oz.; water, 2 pints; boil for 10 or 15 minutes; diuretic.

Decoction Astrin′gent. *Syn.* DECOCTUM ASTRIN′GENS, L. *Prep.* (*Swediaur.*) Oak-bark, pomegranate peel and tormentil root, of each, 2 dr.; water and milk, of each, 1 lb.; boil 12 minutes, add of cinnamon, 2 dr.; boil 2 or 3 minutes longer and strain.—*Dose.* A wine-glassful.

Decoction of Avens Root. *Syn.* DECOCTUM GEI. (*Dr A. T. Thompson.*) Avens root, 1 oz.; water, 1 pint; boil for 15 minutes and strain.

Decoction of Baobab Tree. *Syn.* DECOCTUM ADANSONIÆ. Bark of the baobab tree, 6 dr.; water, $1\frac{1}{2}$ pints; boil to a pint, and strain. Used as a substitute for decoction of bark.

Decoction of Bark. *Syn.* DECOCTION OF CINCHO′NA; DECOCTUM CINCHO′NÆ, L. *Prep.* 1. Ph. L.: *a.* (L. OF YELLOW B.; D. CINCHONÆ, B. P.) Yellow cinchona or calisaya bark (bruised), $1\frac{1}{4}$ oz.; distilled water, 1 pint; boil for 10 minutes in a lightly covered vessel; when cold, strain and pour on the marc sufficient to make up 1 pint.

b. (D. OF PALE B.; D. C. PALLIDÆ, Ph. L.) From pale cinchona or loxa bark, as above (*a*).

c. (D. OF RED B.; D. C. RUBRÆ, Ph. L.) From red bark as above (*a*).

2. (Ph. E.) Brown, grey, yellow, or red cin-

chona (bruised), 1 oz.; water, 24 fl. oz.; boil for 10 minutes; when cold, filter the liquor and evaporate it to 16 fl. oz.

3. (Ph. D.) From pale or loxa bark, similar to the 'Decoctum cinchonæ pallidæ' of Ph. L. (1, *b*, *above*).

Dose, &c. 1 to 2 fl. oz., 3 or 4 times daily, as a tonic, stomachic, and febrifuge, when the stomach will not bear the administration of bark in powder; in fevers, dyspepsia, convalescence, &c. The plan recommended by the Edinburgh College of filtering the decoction when cold is absurd. According to Soubeiran, 146 gr. of the deposit thus removed contained 86 gr. soluble in alcohol, and rich in the cinchona alkaloids. This liquid should, therefore, be well shaken before pouring it out for use, instead of being filtered. The addition of a few drops of either sulphuric or hydrochloric acid to the water greatly increases its solvent power, and also, consequently, the medical value of this preparation (see *below*).

Decoction of Bark (Acid'ulated.) *Syn.* DECOCTUM CINCHONÆ ACIDULA'TUM, L. *Prep.* 1. To the water for any one of the above, add dilute sulphuric acid, 1½ fl. dr.; boil 10 minutes, and strain whilst hot.

2. (*Sir J. Wylie.*) Cinchona bark, 1 oz.; water, 16 fl. oz.; diluted sulphuric acid, 1 dr.; as last.

Decoction of Bark and Ser'pentary. *Syn.* DECOCTUM CINCHONÆ CUM SERPENTA'RIA, L. *Prep.* (*Sir J. Pringle.*) Peruvian bark, 3 dr.; water, 1 pint; boil to one half, and infuse in the hot decoction, serpentaria root, 3 dr. As a diaphoretic stimulant and tonic in fevers, and as a gargle in sore throat.

Decoction of Bar'ley. *Syn.* BARLEY-WATER; DECOCTUM HORDEI (B. P.), L. *Prep.* 1. (B. P.) Pearl barley, 1 oz. (washed clean); boil for 20 minutes in 15 oz. of water and strain.

2. (Ph. D.) Similar to above. (See *Obs. below*).

Decoction of Barley (Compound). *Syn.* PEC'TORAL DECOCTION, FE'VER DRINK; DECOCTUM PECTORA'LE, PTISAN'A COMMU'NIS, DEC. HOR'DEI COMPOS'ITUM (Ph. L.), MISTU'RA HOR'DEI (Ph. E.), L. *Prep.* 1. (Ph. L.) Decoction of barley (simple), 1 quart; figs (sliced), and raisins (stoned), of each, 2½ oz.; fresh liquorice (sliced), 5 dr.; water, 1 pint; boil to a quart and strain.

2. (Ph. E.) Pearl barley, 2½ oz.; water, 4½ pints; boil to 3 pints; add figs and raisins, of each, 2½ oz.; liquorice root, 5 dr.; water, 1 pint; and boil to 2 pints, as before.

Obs. The above are used as demulcents in fevers, phthisis, strangury, &c., taken *ad libitum.* They are slightly laxative, and when this would be an objection to their use, a few drops of laudanum may be added. Mixed with an equal quantity of decoction of bark, barley-water forms an excellent gargle in cynanche maligna (ulcerated sore throat), and, with a like quantity of milk and a little sugar, a good substitute for the breast in dry-nursing infants. It is, also, often acidulated with lemon juice or sulphuric acid, and sweetened (Decoctum hordei acidulatum), Gum-arabic, 4 dr., and nitre, 1 dr., to each pint, is a common addition in gonorrhœa. Cream of tartar, 1 dr. is occasionally added to render it more aperient.

Decoction of Bistort. *Syn.* DECOCTUM BISTORTÆ. Bistort root, 2 oz.; water, 1½ pints; boil 15 or 20 minutes and strain.—*Dose,* 1 oz. to 2 oz.; astringent.

Decoction, Bit'ter. *Syn.* DECOCTUM AMA'RUM, L. *Prep.* 1. Dried tops of lesser centaury and wormwood, and leaves of germander, of each, 3 dr.; water, 1¼ pints; boil to a pint.

2. Gentian root, ½ oz.; water, 1½ pints; boil 10 minutes, take out the root, slice it, and add it again to the decoction with dried orange peel, ¼ oz.; boil to 1 pint and strain.

Decoction of Bitter Sweet. *Syn.* ANTIDAR'TROUS AP'OZEM; APOZEMA DULCAMA''RÆ, L. *Prep.* (*Trousseau and Reveille.*) Dulcamara, 1 dr.; water, 16 oz.; boil to 9 oz. and strain. To be taken in three doses during the day. Every other day the quantity is to be increased until 12 dr. or even 2 oz. are taken daily, "so that the patient may begin to feel dryness of the throat, and some disorder of vision and digestion;" and "continue at this quantity for several weeks in succession." In obstinate skin diseases. See DECOCTION OF DULCAMARA.

Decoction of Black Snake Root. *Syn.* DECOCTUM CIMICIFUGÆ. Black snake root, 1 oz.; water, 16 oz.; boil for 10 minutes.—*Dose,* 1 oz. to 2 oz. in rheumatism and dropsy.

Decoction of Blue Cardinal Flowers. *Syn.* DECOCTUM LOBEL'IÆ, D. L. SYPHILIT'ICÆ, L. *Prep.* 1. (P. Cod.) Root of *Lobelia syphilitica,* 1 handful; water, 12 lbs.; boil to 7 lbs. and strain.

2. (*Swediaur.*) Dried root, 5 oz.; water 12 lbs.; as last. Alterative, purgative, and diuretic.

Obs. This decoction was strongly recommended by Swediaur in certain complaints. He gave ½ pint at first, twice daily, and afterwards 4 times a day, unless it acted too strongly on the bowels, when the frequency of the dose was diminished, or it was discontinued for 3 or 4 days and then had recourse to again, until the cure was effected.

Decoction of Bran. *Syn.* DECOCTUM FURFURIS, L. *Prep.* 1. From bran, ¼ lb.; water, 1½ pints; boil to pint. In diabetes; and sweetened with sugar, as a demulcent and laxative in cough and sore throat.

2. Bran, 1 quart; water, 1½ galls.; boil 5 minutes, and add cold water, q. s. to bring it to the proper temperature. As an emollient foot-bath.

Decoction of Broom. *Syn.* DECOCTUM SPAR'TII CACUMIN'IUM; D. SCOPA''RII (Ph. D.), L. *Prep.* (Ph. D.) Broom-tops (dried), ½ oz.; water, ½ pint; boil 10 minutes and strain.

2. (Ph. B.) Broom-tops (dried), 1 oz.; distilled water, 1 pint; boil for 10 minutes and strain (see *below*).

Decoction of Broom (Compound). *Syn.* DECOCTUM SPAR'TII CACUMINIUM C., D. SCOPA''RII (Ph. E.), D. S. COMPOS'ITUM (Ph. L.), L. *Prep.* 1. (Ph. L.) Tops of broom (recent and dried), juniper berries (bruised), dandelion root (bruised), of each, ½ oz.; distilled water, 1½ pints; boil to a pint and strain.

2. (Ph. E.) Tops of broom and juniper, of each, ½ oz.; cream of tartar, 2½ dr.; water, 1½

pints; boil to a pint, as last. The above are diuretic and laxative.—*Dose*, ½ to 1 wine-glassful, 3 or 4 times a day; in dropsy, especially of the belly (ASCITES).

Decoction of Buckbean. *Syn.* DECOCTUM MENYANTHIS. Buckbean, 1 oz.; water, 1½ pints; boil to a pint.

Decoction of Burdock. *Syn.* DECOCTUM ARC'TII, D. BARDA'NÆ, D. *Prep.* 1. Bardana root, 6 oz.; water, 5 pints; boil to 3 pints and strain.

2. (*Wood.*) Dried root, 2 oz.; water, 3 pints; boil to 2 pints and strain. As an alterative; a pint or more daily, in all those cases in which sarsaparilla is recommended.

Decoction of Cabbage-tree Bark. DECOCTUM GEOFFROYÆ (Ph. E. 1817), D. G. INNERMIS (Ph. D. 1826). *Prep.* (Ph. D.) Bark of the cabbage tree (bruised), 1 oz.; water, 1 quart; boil to a pint and strain. Cathartic, narcotic, and anthelmintic.—*Dose*, 2 to 4 table-spoonfuls for an adult; 1 to 2 teaspoonfuls for a child, followed by demulcents and castor oil; in worms, &c.

Decoction of Calumba (Compound). *Syn.* DECOCTUM CALUM'BÆ COMPOS'ITUM, L. *Prep.* (Ph. U. S. 1831.) Calumba and quassia, of each, 2 dr.; orange peel, 1 dr.; rhubarb, 20 gr.; carbonate of potassa, 30 gr.; water, 20 fl. oz.; boil to 16 fl. oz., strain, and, when cold, add of compound tincture of lavender, ½ fl. oz. Bitter, tonic, and stomachic.—*Dose*, 1 to 2 table-spoonfuls 3 or 4 times daily.

Decoction of Centaury. *Syn.* DECOCTUM CIMICIFUGE, F. H. Lesser centuary, 2 oz.; water, 2 pints; boil for a few minutes and strain.

Decoction of Cey'lon Moss. *Syn.* DECOCTUM FU''CI AMYLA'CEI, D. PLOCA''RIÆ CANDI'DÆ, L. *Prep.* From Ceylon moss, 2 dr.; water, milk, or whey, 1 pint; boil to 16 fl. oz. and strain. It may be sweetened and flavoured. In irritation of the mucous membranes and in phthisis.

Decoction of Cham'omile. *Syn.* DECOCTUM ANTHE'MIDIS, D. CHAMÆMELI, L. From chamomiles, 1 oz.; boiling water, 1 pint; digest for 10 minutes, simmer gently for 2 or 3 minutes longer, and strain with pressure (see *below*).

Decoction of Chamomile (Compound). *Syn.* DECOCTUM CHAMÆMELI COMPOSITUM, L. *Prep.* (Ph. D. 1826.) Chamomile flowers (dried), ½ oz.; fennel seed, 2 dr.; water, 16 oz.; boil for a short time and strain. Both the above are bitter, stomachic, and tonic; the last is vermifuge. They are chiefly used as fomentations and clysters.

Decoction of Cherry Laurel Bark. *Syn.* DECOCTUM LAURO-CERASI CORTICIS. (*Dr Kastner.*) Cherry laurel bark, 2 oz.; water, 2 pints; boil and strain.

Decoction of Chiret'ta. *Syn.* DECOCTUM CHIRAYTÆ, L. *Prep.* From chiretta or chyrata, 5 dr.; water, 1 pint; boil 8 or 10 minutes and strain.—*Dose*, ½ to 1 wine-glassful 2 or 3 times daily, as a stomachic tonic; in flatulency and acidity, especially in the dyspepsia of gouty persons.

Decoction of Cincho'na. See DECOCTION OF BARK.

Decoction of Col'ocynth. *Syn.* DECOCTUM COLOCYNTH'IDIS, L. *Prep.* (Ph. Bat.) Colocynth pulp, 1 dr.; water, 8 oz.; boil 10 minutes, and when quite cold, add of syrup of orange peel, 1 oz.; sulphuric ether, 1 dr.—*Dose*, 2 to 6 dr., 2 or 3 times a day; in dropsy, &c.

Decoction of Colts'foot. *Syn.* DECOCTUM TUSSILAG'INIS, L. *Prep.* (*Pereira.*) Fresh leaves of coltsfoot, 2 oz. (or flowers, 1 oz.); water, 2 pints; boil to a pint and strain. A popular remedy in chronic coughs and chest diseases. It is emollient and demulcent.—*Dose*, ½ a teacupful, *ad libitum* (see *below*).

Decoction of Coltsfoot (Compound). *Syn.* DECOCTUM TUSSILAGINIS COMPOSITUM, L. *Prep.* (*Taddei.*) Coltsfoot flowers, 6 oz.; figs, raisins, and jujubes, of each, 2 oz.; water, 12 pints; boil down to 4 pints; add liquorice root, 2 oz.; again boil and strain. As the last.

Decoction, Com'mon. See DECOCTION OF MALLOWS.

Decoction of Cot'ton Root. *Syn.* DECOCTUM GOSSYP'II, L. *Prep.* (*Dr Bouchelle.*) Inner part of the root of the cotton plant, 4 oz.; water, 1 quart; boil to a pint.—*Dose.* A wine-glassful, occasionally, as an emmenagogue; or, every 30 or 40 minutes, to produce uterine contractions, for which purpose it is said to be as effectual as ergot of rye.

Decoction of Dandeli'on. *Syn.* DECOCTUM TARAX'ACI (B. P.), L. *Prep.* 1. (B. P.) Fresh dandelion root (bruised), 1 oz.; water, 1½ pints; boil to a pint and strain.

2. (Ph. E.) Herb and root (fresh), 7 oz.; water, 1 quart; boil to a pint. Aperient, stomachic, and tonic.—*Dose*, 1 to 2 fl. oz., or more, 2 or 3 times daily.

Decoction of Dog-grass. *Syn.* DECOCTUM GRAMIN'IS, L.; PTISANE CHIENDENT, Fr. *Prep.* From dog-grass root (*Triticum repens*), 1 oz.; liquorice root, ½ oz.; water, 1 quart; boil 20 minutes and strain. Aperient and pectoral; by cupfuls, *ad libitum* (see *below*).

Decoction of Dog-grass (Ioduret'ted). *Syn.* DECOCTUM GRAMINIS IODURE'TUM, L. *Prep.* (*Magendie.*) Decoction of dog-grass, 32 fl. oz.; syrup of peppermint, 2 oz.; iodide of potassium, ½ dr.; mix. By cupfuls, *ad libitum.*

Decoction of Dog-wood. *Syn.* DECOCTUM COR'NUS FLORIDÆ, L. *Prep.* (Ph. U. S.) Dog-wood bark (bruised), 1 oz.; water, 1 pint; boil 10 minutes and strain whilst hot. Tonic and astringent; recommended as a substitute for bark. —*Dose.* A wine-glassful.

Decoction of Dulcama'ra. *Syn.* DECOCTION OF BITTER SWEET, D. OF WOODY NIGHTSHADE; DECOCTUM DULCAMA''RÆ (Ph. L. E. and D.), L. *Prep.* 1. (Ph. L.) Woody nightshade or bitter sweet (the new shoots), 10 dr.; water, 1½ pints; boil to a pint and strain.

2. (Ph. E.) Dulcamara (chopped small), 1 oz.; water 24 fl. oz.; boil to a pint, and strain.

3. (Ph. D.) Twigs of woody nightshade, 1 oz.; water, 1 pint; boil 10 minutes, in a covered vessel, and strain. It should measure about 16 fl. oz. Alterative, diaphoretic, and diuretic.—*Dose.* A wine-glassful, or more, 2 or 3 times a day; in chronic coughs and chronic skin diseases, and in most of those cases wherein sarsaparilla proves useful. See DECOCTION OF BITTER SWEET (also *below*).

Decoction of Dulcama'ra (Compound). *Syn.* DECOCTION DULCAMA''RÆ COMPOSI'TUM, L.

Prep. 1. (*Augustin.*) Dulcamara (bitter sweet), 4 dr.; burdock root, liquorice root, sassafras chips, and guaiacum wood, of each, 2 dr.; water, 2 lbs.; boil to 16 fl. oz. and strain.—*Dose*, 1 to 2 wine-glassfuls, 2 or 3 times a day.

2. (*Foy.*) As the last, but using dulcamara, 2 oz.—*Dose*, ½ to 1 wine-glassful; in similar cases to those in which the simple decoction is given, especially in chronic rheumatism and venereal affections.

Decoction of El′der Bark. *Syn.* DECOCTUM SAMBU″CI, D. S. CORTICIS, L. *Prep.* 1. (*Sydenham.*) Inner bark of elder, 1 oz.; water and milk, of each, 1 pint; boil to one half and strain.

2. (*Collier.*) Bark, 1 oz.; water, 16 fl. oz.; boil to ½ pint and strain.

3. (*Pereira.*) Bark, 1 oz.; water, 1 quart; boil to one half.—*Dose*, 1 wine-glassful, 2 or 3 times a day; as an aperient and resolvent in various chronic disorders, in dropsy, and in certain cutaneous affections; or, 2 wine-glassfuls, as before, as a hydragogue cathartic in dropsies.

Decoction of Elecam′pane. *Syn.* DECOCTUM HELEN″II, D. INU′LÆ, L. *Prep.* (Ph. U. S.) Elecampane root, ½ oz.; water, 1 pint; boil a few minutes and strain. Tonic and expectorant, and, in some cases, diuretic and diaphoretic.—*Dose.* A wine-glassful every hour or two (see *below*).

Decoction of Elecampane (Compound). *Syn.* DECOCTUM HELENI COMPOSITUM, D. INULÆ, C., L. *Prep.* (*Rotier.*) Elecampane, 1 oz.; hyssop and ground ivy, of each, 2 dr.; water, 1 pint; boil 15 minutes, strain, and add of honey, 2 oz.—*Dose*, 1 to 3 table-spoonfuls; as the last.

Decoction of Elm Bark. *Syn.* DECOCTUM UL′MI (B. P.), L. *Prep.* Elm bark (cut in small pieces), 1 oz.; distilled water, 16 oz.; boil to 8 oz. and strain.—*Dose*, 2 to 4 oz., 3 or 4 times a day, as a cheap substitute for sarsaparilla in scaly skin diseases (see *below*).

Decoction of Elm Bark (Compound). *Syn.* DECOCTUM ULMI COMPOSITUM, L. *Prep.* (*Jeffrey.*) Simple decoction of Elm bark, 8 pints; liquorice root, sassafras and guaiacum chips, of each, 1 oz.; mezereon root, 3 dr.; boil for 1 hour and strain. More active than the last.

Decoction of Ergot. *Syn.* DECOCTUM ERGOT′Æ, D. SECA′LIS CORNUTI, L. *Prep.* (*Pereira.*) Ergot of rye (bruised), 1 dr.; water, 6 fl. oz.; boil 10 minutes and strain.—*Dose*, 1-3rd at intervals of ½ hour, until the whole is taken; as a parturifacient.

Decoction of Fern Root. *Syn.* DECOCTUM FILICIS; D. RADICIS F., L. *Prep.* (*Dr Wood.*) Dried fern-root, 1 oz.; water, 1 pint; boil to 16 fl. oz. and strain. By wine-glassfuls, fasting, until it excites slight nausea; as a vermifuge, more particularly for tapeworm.

Decoction of Figs. *Syn.* DECOCTUM FICI, L. *Prep.* (*Cadet.*) Figs (chopped), 1 oz.; water, 1 pint; boil, and strain. Demulcent and pectoral; taken *ad libitum* (see *below*).

Decoction of Figs (Compound). *Syn.* DECOCTUM FICI COMPOSITUM, L. *Prep.* (*Foy.*) Figs and raisins (chopped), of each, 2 oz.; liquorice root, ½ oz.; boiling water, 1 quart; boil 15 minutes and strain. As the last.

Decoction of Galls. *Syn.* DECOCTUM GAL′LÆ, (Ph. L.) *Prep.* From galls (bruised), 2½ oz.; water, 1 quart; boiled to one half and strained. As an astringent, fomentation, enema, or injection, in prolapsus ani, piles, and leucorrhœa.

Decoction of Guaiacum. *Syn.* DECOCTUM GUAIAC′I (Ph. E.), D. G. COMPOSITUM (Ph. D. 1826), L. *Prep.* 1. (Ph. E.) Guaiacum shavings, 3 oz.; raisins (chopped), 2 oz.; water, 8 pints; simmer down to 5 pints, adding, towards the end, sassafras (rasped or sliced) and liquorice root (bruised), of each, 1 oz.

2. (Ph. D.) Guaiacum wood, 3 oz.; sassafras, 10 dr.; liquorice root, 2½ oz.; water, 10 pints, as last; to strain 5 pints.

Obs. The above form the once celebrated 'Decoction of the Woods.'—*Dose.* A teacupful 3 or 4 times daily, or oftener, in chronic rheumatism, cutaneous diseases, after a course of mercury, &c. Although its virtues are of a very dubious kind, there is no doubt that it frequently does good, especially when persevered in with a sudorific regimen.

Decoction of Hairy Horehound. *Syn.* DECOCTUM BALLOTÆ LANATÆ, L. *Prep.* (*Rehmann.*) Siberian or woolly horehound (*Ballota*), 1½ oz.; water, 1 quart; boil to one half.—*Dose.* A tumblerful, or more, twice a day; in rheumatic, gouty, and dropsical affections, especially the latter. See DECOCTION OF HOREHOUND.

Decoction of Harts′horn. See MIXTURES.

Decoction of Hel′lebore. 1. (DECOCTION OF BLACK HELLEBORE; DECOCTUM HELLEBORI NIGRI, L.) *Prep.* (*A. T. Thomson.*) Black hellebore root, 2 dr.; water, 1 pint; boil 15 minutes.—*Dose*, 1 fl. oz. every 4 hours; in dropsy, worms, chronic skin diseases, &c., occurring in non-irritable habits.

2. (DECOCTION OF WHITE HELLEBORE; DECOCTUM VERATRI, Ph. L. and D.) *Prep.* (Ph. L. 1836.) White hellebore (bruised), 10 dr.; water, 1 quart; boil to a pint, and, when cold, add of rectified spirit, 3 fl. oz. Used as a lotion in itch, lepra, psoriasis, scald-head, &c., and to destroy pediculi. In most cases it should be diluted with water, and should never be applied to the unsound skin.

Decoction of Holly Leaves. *Syn.* DECOCTUM ILICIS. (*Foy.*) Holly leaves, ½ oz.; water, 16 oz.; boil to 12 oz. For 3 doses.

Decoction of Horehound. *Syn.* COMPOUND DECOCTION OF HOREHOUND; DECOCTUM MARRUBII COMPOSITUM, L. *Prep.* (*Dr R. E. Griffith.*) Dried horehound (*Marrubium vulgare*), 1 oz.; liquorice root and flax-seed (bruised), of each, ½ oz.; boiling water, 1½ pints; macerate for 3 or 4 hours (boil a minute) and strain. An excellent demulcent and pectoral.—*Dose*, 1 to 2 fl. oz., as required, in coughs, &c.

Decoction of Iceland Moss. *Syn.* DECOCTION OF LIVERWORT; DECOCTUM CETRARIÆ (Ph. L.); D. LICHENIS ISLANDICI (Ph. D.); D. LICHENIS (Ph. L. 1824.) *Prep.* 1. (Ph. L.) Liverwort (Iceland moss), 5 dr.; water, 1½ pints; boil to a pint and strain.

2. (Ph. D.) Iceland moss, 1 oz.; water, 1½ pints; boil for 10 minutes in a covered vessel, and strain. Nutritious, demulcent, pectoral, and tonic.—*Dose*, 1 to 4 fl. oz., every 3 or 4 hours;

in chronic affections of the chest and stomach, especially pulmonary consumption, old coughs, dyspepsia, chronic diarrhœa, and dysentery. It may be flavoured and sweetened; milk is frequently added to it. The bitter matter may be removed by steeping the moss for some time in pretty warm water, or in cold water, to which a very little carbonate of potash has been added. Without this is done, it is intensely bitter and nauseous.

Decoction of Indian Ba′el. *Syn.* DECOCTION OF ÆGLE MARMELOS; DECOCTUM BAEL, L. From the dried unripe fruit of *Ægle marmelos* (Indian bael), 2 oz.; water, 1 pint; boil to 1·3rd and strain.—*Dose*, 2 fl. oz. 2 or 3 times a day; in dysentery, diarrhœa, and English cholera.

Decoction of Indian Pink. *Syn.* DECOCTUM SPIGELLIÆ, L. *Prep.* Indian pink root, 5 dr.; water, 1 pint; boil 5 minutes; add senna, 4 dr.; digest 15 minutes, strain, and add of manna, 1 oz. —*Dose.* A small teacupful, 3 times a day, for an adult; ½ oz. to 1 oz. or less, for children; as an anthelmintic purge.

Decoction of Indian Sarsaparilla. *Syn.* DECOCTUM HEMEDES′MI, L. *Prep.* (*Pereira.*) Root of Indian sarsaparilla (*Hemedesmus indicus*), 2 oz.; water, 1½ pints; boil to a pint. Diuretic, alterative, and tonic.—*Dose.* By wine-glassfuls, as decoction of sarsaparilla.

Decoction of I″rish Moss. *Syn.* DECOCTUM CHON′DRI. *Prep.* (*Pereira.*) Carrageen or Irish moss, 1 oz.; macerate in lukewarm water for 10 minutes, take it out and drain it, and then boil it in water (or milk), 3 pints, for 15 minutes, and strain through linen.

Obs. If twice the above weight of moss is employed, a mucilage (*mucilago chondri*) is produced, which may be flavoured with lemon juice, spices, &c., and forms a most nutritious article of spoon diet. It is taken in the same cases as decoction of Iceland moss; and is frequently employed in cookery as a substitute for animal jelly, and in the preparation of blancmanges, soups, &c.

Decoction of I″singlass. See LISBON DIET DRINK.

Decoction of Jamaica Dogwood. *Syn.* DECOCTUM CORNUS FLORIDÆ. (U. S. Ph.) Bark of Jamaica dogwood, 1 oz.; water, 16 oz. o.m.; boil 10 minutes and strain, and make up to 1 pint o.m. As a substitute for cinchona, but is more astringent.

Decoction of Jujubes. *Syn.* DECOCTUM JUJUBARUM. Boil 2 oz. of jujubes (stoned), for an hour, in a sufficient quantity of water to produce 2 pints of decoction.

Decoction of Ju′niper Berries (Compound). *Syn.* DECOCTUM JUNIPERI COMPOSITUM, L. *Prep.* (St B. Hosp.) Juniper berries, 2 oz.; cream of tartar, 3 dr.; water, 4 pints; boil to a quart, strain, and add compound spirit of juniper, 2 fl. oz. Diuretic.—*Dose*, 2 or 3 wine-glassfuls, 3 times a day, warm.

Decoction of Linseed (Compound). *Syn.* DECOCTUM LI′NI COMPOSITUM (Ph. D.), L. *Prep.* (Ph. D.) Linseed, 1 oz.; liquorice root (bruised), ⅛ oz.; water, 1½ pints; boil for 10 minutes in a covered vessel, and strain whilst hot. Emollient and demulcent.—*Dose.* A wine-glassful *ad libitum*; in gonorrhœa, dysentery, pulmonary affections, &c. It may be flavoured with lemon peel, and sweetened. See INFUSIONS.

Decoction of Liquorice. *Syn.* DECOCTUM GLYCYRRHIZÆ, L. *Prep.* (Ph. D. 1826.) Liquorice root (sliced), 1½ oz.; water, 16 fl. oz.; boil 10 minutes and strain. A mild demulcent; it is taken either alone, by wine-glassfuls, or is used as a vehicle for more active remedies.

Decoction, Lisbon. See LISBON DIET DRINK.

Decoction of Liv′erwort. See DECOCTION OF ICELAND MOSS.

Decoction of Log′wood. *Syn.* DECOCTUM HÆMATOXYLI (Ph. L. E. & D.), L. *Prep.* 1. (Ph. L.) Logwood chips, 10 dr.; water, 1½ pints; boil to a pint and strain.

2. (Ph. E.) Logwood, 1 oz.; water, 1 pint; boil to 10 fl. oz., adding towards the last, cinnamon (in powder), 1 dr.

3. (Ph. D.) Logwood, 1 oz.; water, ½ pint. Astringent and tonic.—*Dose*, 1 table-spoonful to a wine-glassful; in diarrhœa, as required.

4. (Ph. B.) Logwood in chips, 1 oz.; cinnamon in coarse powder, 55 gr.; distilled water, 1 pint. Boil the logwood for 10 minutes, then add the cinnamon and strain to make up 1 pint.

Decoction of Mal′lows. *Syn.* COMMON DECOCTION; DECOCTUM COM′MUNE, D. PRO ENEMA′TE (Ph. L. 1787), D. MALVÆ COMPOSITUM (Ph. L. 1836), L. *Prep.* (Ph. L. 1836.) Common mallows (dried), 1 oz.; chamomile flowers (dried), ½ oz.; water, 1 pint; boil 15 minutes and strain. Used chiefly for fomentations and enemas.

Decoction of Malt. *Syn.* DECOCTUM BI′NÆ, D. BYNES, D. MALTI, L. *Prep.* (*Swediaur.*) Ground malt, 3 oz.; water, 1 quart; boil to a pint and strain. 1 oz. of syrup of lemons, or of saffron, may be added to the cold decoction, or a little liquorice root with the malt. Demulcent and laxative.—*Dose.* A cupful *ad libitum.* Infusion of malt (sweet wort) is a more convenient and elegant preparation.

Decoction of Marsh-mal′low. *Syn.* DECOCTUM ALTHÆ′Æ (Ph. D. 1826 and Ph. E. 1813), L. *Prep.* (Ph. D. 1826.) Dried root and herb of marsh-mallow, 4 oz.; raisins (stoned), 2 oz.; water, 7 pints (wine measure); boil down to 5 pints, strain, allow it to deposit the sediment, and decant the clear liquid. Demulcent.—*Dose.* A cupful *ad libitum*, in coughs, colds, calculous affections, and other diseases of the urinary organs. See MIXTURES.

Decoction of Matico. *Syn.* DECOCTUM MATICO′NIS, L. *Prep.* (*Dr Jeffreys.*) Matico leaves, 1 oz.; water, 1 pint; boil 12 minutes and strain. Astringent.—*Dose*, 1 fl. oz., 2 or 3 times a day; in hæmorrhagic and other discharges.

Decoction of Meze′reon. *Syn.* DECOCTUM MEZEREI (Ph. E. and Ph. D. 1826), L. *Prep.* (Ph. E.) Root-bark of mezereon, 2 dr.; liquorice root, 4 dr.; water, 1 quart; simmer to 1½ pints and strain. Stimulant and sudorific.—*Dose.* A wine-glassful, or more, 3 or 4 times a day; in chronic rheumatism, scrofula, secondary syphilis, lepra, and some other cutaneous affections. Much boiling injures the virtues of mezereon (see *below*).

Decoction of Meze′reon (Compound). *Syn.* DECOCTUM MEZEREI COMPOSITUM, L. *Prep.* (*Van

Mons.) Mezereon, 2 dr.; bitter-sweet, 4 dr.; burdock, 2 oz.; water, 2 quarts; boil to 3 pints, add of liquorice root, 2 dr., and strain. As the last, and in obstinate diseases of the skin.

Decoction of Mugwort. *Syn.* DECOCTUM ARTEMISIÆ VULGARIS. Mugwort root, 1 oz.; water, 24 oz. Boil for ½ hour. In epilepsy.

Decoction of Myrrh. *Syn.* DECOCTUM MYRRHÆ. (Ph. D.) Myrrh, 2 dr.; water, 8½ oz.; triturate the myrrh with the water gradually added; then boil for 10 minutes, in a covered vessel, and strain.

Decoction of Ni'tre. *Syn.* DECOCTUM NITROSUM, D. NITRATUM, D. POTASSÆ NITRATIS, L. *Prep.* 1. Nitre, ½ oz.; white sugar, 2 oz.; cochineal, 20 gr.; water, 1½ pints; boil a few minutes and strain.

2. (Hosp. Form.) Barley-water, 1 pint; nitre, 5 dr.; dissolve. Diuretic, diaphoretic, and refrigerant. A wine-glassful, frequently; in gonorrhœa, sore throat, acute rheumatism, scurvy, &c.

Decoction of Oak Bark. *Syn.* DECOCTUM QUERCÛS (Ph. L. E. & D.), L. *Prep.* 1. (Ph. L. & E.) Oak bark (bruised), 10 dr.; water, 1 quart; boil down to a pint and strain.

2. (Ph. D.) Oak bark, 1½ oz.; water, 1½ pints; boil 10 minutes and strain. Astringent. Used as a gargle in ulcerated sore throat, relaxation of the uvula, &c., and as a wash, and as an injection in piles, leucorrhœa, hæmorrhages, prolapsus ani, &c.

3. (Ph. B.) Oak bark (bruised), 1½ oz.; distilled water, 1 pint; boil for 10 minutes and strain.

Decoction of Oats. *Syn.* WATER GRUEL; DECOCTUM AVENÆ, L. *Prep.* 1. (*Cullen.*) Oatmeal, 1 oz.; water, 3 quarts; boil to a quart, strain, and when cold decant the clear liquid from the sediment.

2. (*A. T. Thomson.*) Washed groats, 4 oz.; water, 4 pints; boil to a quart. Nutritious and demulcent. Taken *ad libitum,* to promote the action of purgatives, and as an enema, either alone, or as a vehicle for more active substances. It is too thin for food. See GRUEL.

Decoction of Parei'ra. *Syn.* DECOCTUM PAREIRÆ (Ph. L.), L. *Prep.* 1. (Ph. L.) *Pareira brava* root (sliced), 10 dr.; water, 1½ pints; boil to a pint and strain.

2. (*Sir B. Brodie.*) Pareira, 4 dr.; water, 3 pints; boil to a pint, as last. The above are given in gonorrhœa, leucorrhœa, and chronic inflammation of the bladder.—*Dose.* Of the first, ½ to 1 wine-glassful, 3 or 4 times a day; of the second, about twice that quantity, or more. It is commonly combined with some tincture of hyoscyamus; and when the triple phosphates are present in the urine, dilute hydrochloric or nitric acid may be added. See PAREIRA.

Decoction, Pec'toral. See DECOCTION OF BARLEY.

Decoction of Pel'litory. DECOCTUM PYRE''THRI, L. *Prep.* (Guy's Hosp.) Pellitory root, 1 oz.; water, 1½ pints; boil to a pint and strain. Used as a gastric stimulant, and as a gargle in the relaxation of the uvula.

Decoction of Pome'granate. *Syn.* DECOCTUM GRANA'TI (Ph. L.), L. *Prep.* (Ph. L.) Pomegranate rind (fruit-bark), 2 oz.; distilled water, 1½ pints; boil to a pint and strain. Astringent. Used as a gargle and injection, in sore throat, leucorrhœa, &c.; and internally, in diarrhœa, dysentery, &c.—*Dose,* 1 fl. oz., or more.

Decoction of Pomegranate Root. *Syn.* DECOCTUM GRANATI RADICIS (Ph. L.), L. *Prep.* 1. (Ph. L.) Root-bark of pomegranate (sliced), 2 oz.; water, 1 quart; boil to a pint and strain.

2. (*Collier.*) Bark of the root, 2 oz.; water, 1 pint; boil to one half. This is the common form used in India.

Dose, &c. A wine-glassful, half-hourly, until the whole is taken, a light diet and a dose of castor oil having been taken the day previously. In tapeworm, Dr Collier recommends the whole of the last preparation to be given in 2 doses, at the interval of 2 hours. It purges, and in 5 or 6 hours frequently expels the worm; if this does not take place, it should be persevered in. "Look for the head of the tænia (tapeworm); for if that is not expelled, you have done nothing" (*Collier*). Oil of turpentine and kousso are now more frequently given in tænia in this country.

Decoction of Poppies. *Syn.* DECOCTION OF POPPY-HEADS, FOMENTATION OF P.-H.; DECOCTUM PAPAVERIS (Ph. L. E. & D.), L. *Prep.* 1. (Ph. L.) Poppy-heads (bruised), 4 oz.; water, 2 quarts; boil for 15 minutes and strain.

2. (Ph. E. & D.) As the last, but using only 3 pints of water. Used as an emollient fomentation, in painful swellings, excoriations, &c. The addition of a ¼ pint of vinegar is said to promote its efficacy.

3. (Ph. B.) Poppy-heads (bruised), 2 oz.; distilled water, 1½ pints. Boil for 10 minutes and strain. The product should measure a pint.

Decoction of Quas'sia. *Syn.* DECOCTUM QUASSIÆ, L. *Prep.* From quassia chips (small), 1 dr.; water, 1¼ pints; boil to a pint, and add syrup of orange peel, 2 oz.—*Dose.* A wine-glassful, occasionally, as a stomachic tonic. See INFUSIONS.

Decoction of Quince. *Syn.* DECOCTION OF QUINCE SEED, MUCILAGE OF Q. S.; DECOCTUM CYDONII (Ph. L.), L. *Prep.* From quince seeds, 2 dr.; water, 1 pint; boil for 10 minutes and strain. Used as an emollient and sheathing application to abraded or wounded surfaces, as cracked lips, nipples, &c.; and to the skin in erysipelas, to painful hæmorrhoidal tumours, and the like. Prepared with a little less water, it is used by the hairdresser as 'bandoline' or 'fixateur.'

Decoction of Red Gum. *Syn.* DECOCTUM GUMMI RUBRI. (*Mr Squire.*) Red gum, 1 oz.; water, 2 pints; boil 10 minutes and strain.

Decoction of Rice. *Syn.* RICE WATER, RICE DRINK; DECOCTUM ORY'ZÆ, L. *Prep.* Rice, 2 oz.; water, 1 quart; boil to one half and strain. Demulcent. A good drink in fevers, coughs, &c., either alone or sweetened and flavoured with a little lemon peel.

Decoction of Sarsaparil'la. *Syn.* DECOCTUM SAR'ZÆ (Ph. L. & E.), D. SARSAPARILLÆ (Ph. D.), L. *Prep.* 1. (Ph. L.) Sarsaparilla (sliced), 5 oz.; water, 2 quarts; boil to a quart and strain.

2. (Ph. E.) Sarsaparilla, 5 oz.; boiling distilled water, 4 pints; macerate for 2 hours in a vessel lightly covered, and placed in a warm situation; then take out the root, bruise it, return it again to the liquor, boil down to a quart, and strain.

3. (Ph. D.) Sarsaparilla, 2 oz.; boiling water, 1½ pints; digest an hour, boil 10 minutes, cool, and strain.

4. (Ph. B.) Digest 2½ oz. of Jamaica sarsaparilla cut transversely in 1½ pints of boiling water for an hour, boil for 10 minutes, cool, and strain. Make up to 1 pint.

Obs. The medicinal virtues of sarsaparilla root reside wholly in the bark, or cortical portion; it is therefore quite unnecessary to bruise it, as directed in the Ph. E. By those houses which deal largely in decoction of sarsaparilla, the root is seldom split or cut; the bundles in which it is made up being simply untied and spread open, to allow of the free exposure of every part to the solvent action of the water. By this plan the whole of the soluble portion of the bark is extracted, whilst the feculent matter that pervades the wood is only partially dissolved out. According to Soubeiran, a mere infusion is preferable. The dose is a teacupful to ½ pint 3 or 4 times a day.

An extemporaneous decoction of sarsaparilla is made by dissolving ¾ oz. of the simplest extract in 1 pint of hot water. See SARSAPARILLA, and *below*.

Decoction of Sarsaparilla (Concentrated). *Syn.* DECOCTUM SARZÆ CONCENTRATUM, L. *Prep.* 1. (Wholesale.) Sarsaparilla (Jamaica), 10½ lbs., is placed in a large and well-cleaned copper boiler, and enough boiling water added to cover it; it is then left to macerate, without boiling, for 3 or 4 hours, after which it is boiled for about an hour, and the clear liquor drawn off into another clean copper pan; the root (after it has well drained) is then washed or 'sparged' with boiling water, until the latter runs off scarcely coloured; the washings are added to the decoction, and the whole evaporated as quickly as possible to 6½ pints; it is then set to cool, and rectified spirit of wine, 1½ pints, further added; after agitation, the whole is set aside in a well-corked bottle, in a cool place, for a week. In a few days it is usually found as clear and brilliant as brandy, with very little sediment, and will keep for any length of time uninjured. Some manufacturers, instead of washing the root, give it a second and third water, boiling it each time and evaporating the mixed liquors.

2. (Extemporaneous.) Extract of sarsaparilla, 6½ oz.; water, 12 fl. oz.; dissolve, add rectified spirit, 2½ fl. oz., and water, q. s. to make the whole exactly measure a pint.

Obs. 1 dr. of this decoction mixed with 7 dr. of water forms a similar preparation to the *Decoctum sarzæ* of the Ph. L., and is now very frequently substituted for it in dispensing. See SARSAPARILLA, EXTRACTS, and *below*.

Decoction of Sarsaparilla (Compound). *Syn.* DECOCTUM SARZÆ COMPOSITUM (Ph. L. & E.), D. SARSAPARILLÆ C. (Ph. D.), L. *Prep.* 1. (Ph. L.) Decoction of sarsaparilla (boiling), 4 pints; sassafras chips, guaiacum wood (rasped), and fresh liquorice root (bruised), of each, 10 dr.; mezereon (root-bark), 3 dr.; boil for 15 minutes and strain.

2. (Ph. E.) As the last, but using 4 dr. of mezereon.

3. (Ph. D.) Sarsaparilla (sliced), 2 oz.; sassafras, guaiacum turnings, and liquorice root (bruised), of each, 2 dr.; mezereon root-bark, 1 dr.; boiling water, 1½ pints; digest for an hour, then boil for 10 minutes, cool, and strain.

4. (Extemporaneous.) Compound extract of sarsaparilla, 7½ dr.; boiling water, 1 pint; dissolve.

5. (Ph. B.) Jamaica sarsaparilla, cut transversely, 2½ oz.; sassafras, guaiacum turnings, bruised liquorice root, of each, ¼ oz.; mezereon root-bark, 60 gr.; digest them with 1½ pints of boiling water in a covered vessel for an hour, then boil for 10 minutes, cool, and strain. Make up to 1 pint.

Obs. This decoction is an imitation of the once justly celebrated 'Lisbon Diet Drink.' It is an alterative and diaphoretic.—*Dose.* A teacupful, or more, 3 or 4 times a day, either along with, or after, a mercurial course; and in syphilis, scurvy, scrofula, chronic rheumatism, lepra, psoriasis, and several other skin diseases, and especially in cachexia, or general bad habit of body. During its use the skin should be kept warm. See SARSAPARILLA, and *below*.

Decoction of Sarsaparilla (Concentrated Compound). *Syn.* DECOCTUM SARZÆ COMPOSITUM CONCENTRATUM, D. SARSAPARILLÆ C. C., L. There is a very considerable trade done in this article, in consequence of compound decoction of sarsaparilla being taken in large doses, both alone and in combination with other remedies, and the pharmacopœial preparation spoiling if kept longer than about 12 hours in warm weather. Like the concentrated simple decoction, it is said to be of 8 times the usual strength, so that when mixed with 7 times its weight of water it forms a similar preparation to the *Decoctum sarzæ compositum*, Ph. L., for which it is very generally substituted in dispensing.

Prep. 1. (Wholesale.) Sarsaparilla (red Jamaica), 96 lbs.; mezereon root (not root-bark), 8 lbs.; liquorice root (bruised), 16 lbs. The mezereon and liquorice are first laid (loosely) on the bottom of a clean copper pan, and the bundles of sarsaparilla (untied and loosened) packed over them, in horizontal layers, alternately at right angles with each other. Three or four boards, with as many iron ½-cwt. weights, are next placed on the top of the whole. Water is now run in to about ten inches higher than the ingredients, and heat is applied until ebullition commences. The materials are now allowed to macerate, without boiling, for 3 or 4 hours, after which the liquor is gently boiled for about an hour, care being taken to add fresh water from time to time, so as to keep the whole well covered. The decoction is next run off, and set evaporating as quickly as possible. The ingredients are then washed with successive portions of boiling water by allowing it to descend from a species of shower-bath, after the manner of 'sparging' described under BREWING. This is repeated until the water runs off nearly colourless, the smallest quantity being employed that will effect the object in view. The whole of the liquid is now evaporated without delay until reduced to 8¼ galls., when, after cooling, 2 dr. of essential oil of sassafras dissolved in 2 galls. of rectified spirit of wine are added, and afterwards 1 pint of

essence of guaiacum. The liquid is then placed in a suitably sized barrel set upon its head and fitted with a small cock (not placed too near the bottom), and allowed to repose for a week, by which time it becomes clear and brilliant and fit for sale. This is the form adopted by the large metropolitan drug-houses most celebrated for this preparation. The product that may be drawn off fit for sale is something over 10 galls. The residuum, forming the 'bottoms,' consists chiefly of fecula. The latter is well stirred up with 3 or 4 galls. of cold water, and allowed to settle. The clear decanted 'washings' are used as water or liquor in making the next batch of decoction.

2. (Extemporaneous.) Compound extract of sarsaparilla, 7½ oz.; boiling water, 12 fl. oz.; dissolve, then add of rectified spirit of wine, 2½ fl. oz.; mix well, and further add of water, q. s. to make the whole measure a pint.

Obs. To conduct this process successfully, several large copper pans are required; one of which (to boil the ingredients in) must be capable of containing from 140 to 150 galls. at the least, and the others must be sufficiently large to receive the liquors as they are drawn off. Those for the evaporation should be very shallow, in order that it may proceed rapidly; and the whole should be heated by steam. An excellent plan is to employ large wooden vats, and to apply the heat by means of pipes laid along the bottom, and supplied with high-pressure steam. This method is less expensive than the use of double steam pans, as above. When essence of guaiacum is not used, 24 lbs. of guaiacum shavings, from which the dust has been sifted, are boiled with the other ingredients instead. Those desirous of using the proportions of the ingredients ordered by the Colleges may do so by taking 8 times the given quantities, and proceeding as above. The following are special preparations:

FELTZ'S DECOCTION OF SARSAPARILLA. *Syn.* AP'OZEM OF FELTZ; DECOCTUM SARZÆ CUM ICHTHYOCOL'LA, L.; PTISANE DE FELTZ, Fr. *Prep.* From sarsaparilla (sliced), 3 oz.; isinglass and crude antimony (in powder), of each, ½ oz.; water, 5 pints; boil to one half and strain. Used in skin diseases.

JAUPURAND'S DECOCTION OF SARSAPARILLA. *Syn.* DECOCTUM SARZÆ CUM RADICE CHINÂ, L.; PTISANE DE JAUPERAND, Fr. *Prep.* (*Bories.*) Sarsaparilla and China root, of each, 2 oz.; senna and sassafras chips, of each, ½ oz.; carbonate of potassa, 1 dr.; water, 2 galls.; simmer gently for several hours, and strain 12 pints; when cold decant the clear.—*Dose*, 2 fl. oz., two or three times daily; in scrofula, &c.

VINACHE'S DECOCTION OF SARSAPARILLA. *Syn.* DECOCTUM SARZÆ CUM SENNÂ, L.; PTISANE DE VINACHE, Fr. *Prep.* (*Foy.*) Sarsaparilla, China wood, and guaiacum wood, of each, 1½ oz.; crude antimony (tied in a rag), 2 oz.; water, 6 pints; macerate for 12 hours (7 in hot weather), boil to one half, add sassafras chips and senna, of each, ½ oz.; infuse 1 hour longer and strain; when cold decant the clear. Recommended in scrofula, secondary syphilis, and various cutaneous affections.

ZITTMANN'S DECOCTION OF SARSAPARILLA. *Syn.* DECOCTUM ZITTMANNI, L.; PTISANE DE ZITTMANN, Fr. *Prep.* 1. (STRONGER DECOCTION; D. Z. FORTE, Ph. Bor. 1847.) Sarsaparilla, 12 oz.; water, 72 lbs. (say 5¾ galls.); digest 24 hours, then add (suspended in a bag), white sugar and alum, of each, 6 dr.; calomel, 4 dr.; cinnabar, 1 dr.; boil to 24 lbs., adding towards the end of the process, senna, 3 oz.; liquorice root, 1½ oz.; aniseed and fennel seed, of each, ½ oz.; finally strain with pressure, and after some time decant the clear portion. The formula in the Ph. Suec. 1845 is similar; that in the Hamburg Codex directs only 24 lbs. of water to be used, and the whole to be reduced to 16 lbs.

2. (WEAKER DECOCTION; D. Z. TENUE.—Ph. Bor. 1847.) Add to the residuum (waste) of the last preparation, sarsaparilla, 6 oz.; water, 72 lbs. (say 5¾ galls.); boil to 24 lbs.; adding towards the end of the process, lemon peel, cinnamon bark, liquorice root, and cardamoms (all bruised), of each, 3 dr.; press, strain, &c., as before. In the Ph. Suec. 1845 double the above weights of lemon peel and liquorice root are ordered, and in the Hamburg Codex (1845) 24 lbs. of water only are ordered, and the whole is to be boiled down to 16 lbs.

Obs. Both the above are used in Germany and on the Continent generally, in the same cases as those in which compound decoction of sarsaparilla is administered in England. They may be drunk almost *ad libitum.* A trace of mercury may be detected in the stronger decoction when properly prepared. See SARSAPARILLA.

Decoction of Senega Root. *Syn.* DECOCTION OF AMERICAN SNAKE-ROOT, D. OF RATTLESNAKE-ROOT; DECOCTUM POLYGALÆ, D. SENEGÆ (Ph. L.), L. *Prep.* (Ph. L.) Senega or seneka root, 10 dr.; water, 1 quart; boil to a pint and strain. —*Dose*, ½ to 2 wine-glassfuls, 3 or 4 times daily; in humoral asthma, chronic cough, dropsy, &c. It is stimulant, expectorant, and diuretic, and, in large doses, emetic and cathartic. It is frequently conjoined with ammonia. It is the antidote employed by the Senega Indians against the bite of the rattlesnake (*Dr Tennant*).

Decoction of Simaru'ba Bark. *Syn.* DECOCTUM SIMARU'BÆ, L. *Prep.* (*Dr Wright.*) Simaruba bark, 2 dr.; water, 24 fl. oz.; boil to one half and strain. Tonic.—*Dose*, 1 to 2 fl. oz.; in chronic dysentery and diarrhœa.

Decoction of Squills (Compound). *Syn.* DECOCTUM SCILLÆ COMPOSITUM, L. *Prep.* Ph. U. S. 1841.) Squills, 3 dr.; juniper berries, 4 oz.; snake-root, 3 oz.; water, 4 lbs.; boil to one half, strain, and add of sweet spirits of nitre, 4 fl. oz. In chronic coughs and other chest affections, unaccompanied with active inflammatory symptoms.—*Dose*, 1 to 3 fl. oz., twice or thrice daily.

Decoction of Starch. *Syn.* DECOCTUM AMYLI (Ph. L.), MUCILA'GO AMYLI (Ph. E. and D.), L. *Prep.* (Ph. L. and E.) Starch, ½ oz.; add gradually, water, 1 pint, and boil for a short time. The Dublin preparation is nearly twice as strong. Used as an enema in dysentery, diarrhœa, and excoriations of the rectum.

Decoction of Stavesacre. *Syn.* DECOCTUM STAPHISAGRIÆ. Stavesacre seed, 1 oz.; water, 2

pints; boil for a few minutes, and strain. For external use.

Decoction, Sudorif'ic. *Syn.* DECOCTUM SUDORIF'ICUM, L. The old name of the compound decoctions of sarsaparilla and guaiacum.

Decoction of Su'et. *Syn.* ARTIFICIAL GOAT'S MILK; DECOCTUM SE'VI, D. *Prep.* Suet, 1 oz.; tie it loosely in a piece of muslin and simmer it in cow's milk, $1\frac{1}{4}$ pints; adding towards the last, white sugar, $\frac{1}{2}$ oz. In scrofulous emaciation and phthisis; taken *ad libitum.*

Decoction of Tam'arinds. *Syn.* DECOCTUM TAMARINDO'RUM, L. *Prep.* Tamarinds, $1\frac{1}{2}$ oz.; water, 1 pint; boil for 5 minutes and strain. A pleasant drink in fevers, asthma, chronic coughs, &c.

Decoction of Tamarinds and Senna. *Syn.* DEC. TAMARINDORUM CUM SENNÂ (Ph. E. 1744), L. *Prep.* Tamarinds, 6 dr.; cream of tartar, 2 dr.; water, $1\frac{1}{2}$ pints; boil in a glazed earthen vessel until reduced to 16 oz.; then infuse therein for 12 hours, senna, 4 dr.; strain, and add of syrup of violets, 1 oz. A gentle aperient.—*Dose.* A wine-glassful, or more.

Decoction of Tar. *Syn.* TAR WATER; DECOCTUM PI'CIS LIQ'UIDÆ, L. *Prep.* Tar, 1 oz.; water, $1\frac{1}{2}$ pints; boil to 1 pint.—*Dose.* A pint or more daily; in chronic catarrh; and as a wash in chronic skin diseases, especially those of the head in children.

Decoction, Ton'ic. *Syn.* STRENGTHENING DECOCTION; DECOCTUM ROBORANS, L. *Prep.* 1. Peruvian bark (bruised), $\frac{1}{2}$ oz.; Virginian snake-root, 2 dr.; water, 1 pint; boil to one half, strain whilst hot, and add, spirit of cinnamon, $1\frac{1}{2}$ fl. oz.; diluted sulphuric acid, $1\frac{1}{2}$ dr.—*Dose,* 2 oz. 2 or 3 times a day.

2. Decoction of bark, 5 oz.; tincture of bark, 6 dr.; aromatic confection, $\frac{1}{2}$ dr.; sal-volatile, 1 dr.—*Dose,* 1 or 2 table-spoonfuls night and morning; especially in diarrhœa.

Decoction of Tor'mentil. *Syn.* DECOCTUM TORMENTIL'LÆ (Ph. L.), L. *Prep.* (Ph. L.) Tormentil root (bruised), 2 oz.; water, $1\frac{1}{2}$ pints; boil to a pint and strain. Astringent.—*Dose,* 1 to 2 fl. oz., in chronic diarrhœa, &c.

Decoction of Tur'meric. *Syn.* DECOCTUM CURCU'MÆ, L. *Prep.* From turmeric root (in powder), $1\frac{1}{2}$ oz.; water, 1 pint; boil for 5 minutes and strain. A mild aromatic stimulant and stomachic.—*Dose.* A wine-glassful *ad libitum.* It is principally used as a test for alkalies, which turn it brown. Unsized paper dipped into it and dried forms the turmeric test-paper of the chemist.

Decoction of Walnut Bark. *Syn.* DECOCTUM JUGLAND'IS, L. *Prep.* (Ph. Gen.) Green bark of walnuts, 1 oz.; water, 1 pint; boil for 15 minutes and strain. As an antisyphilitic. Before the general introduction of sarsaparilla it was much esteemed in most cases in which that drug is now taken.—*Dose, &c.* The same as those of comp. dec. of sarsaparilla. Pearson says that "when the putamen (green rind) of the walnut has been omitted, either intentionally or by accident (from *Decoctum lusitanicum*), the same good effects have not followed its use as when it contained this ingredient."

Decoction of Walnut Leaves. *Syn.* DECOCTUM JUGLAND'IS FOLIO''RUM, L. *Prep.* (*Negrier.*) Walnut leaves, 1 handful; water, 1 quart; boil 15 minutes and strain. Detersive, diaphoretic, and alterative. *Dose, &c.* As the last, especially in chronic rheumatism, secondary syphilis, &c.

Decoction of Wa'ter-dock. *Syn.* DECOCTUM RUMI'CIS, D. R. AQUAT'ICI, L. *Prep.* (*A. T. Thomson.*) Root of common water-dock (*Rumex obtusifolius*), 1 oz.; water, 1 pint; boil for 10 minutes and strain.

Obs. This decoction is astringent, and was once much celebrated as a remedy for scurvy and some other cutaneous affections. "It is the only remedy which proves efficacious in that disease when the ulcers are healed, and the patient is attacked with asthma" (*Linnæus,* on the scurvy of the Laplanders).

Decoction, White. (*Sydenham's.*) *Syn.* HARTSHORN DRINK; MIS'TURA COR'NU USTI. *Prep.* Prepared burnt hartshorn, 2 oz.; gum-arabic, 1 oz.; water, 3 pints; boil to 1 quart and strain. Mucilaginous; demulcent. Taken *ad libitum.*

Decoction of Whor'tleberry. *Syn.* DECOCTION OF BEARBERRY, D. OF UVA-URSI; DECOCTUM UVÆ URSI (Ph. L. and D.), L. *Prep.* 1. (Ph. L.) Whortleberry leaves, 1 oz.; water, $1\frac{1}{2}$ pints; boil to a pint, and strain.

2. (Ph. D.) Uva-ursi (the leaves), $\frac{1}{2}$ oz.; water, $\frac{1}{2}$ pint; boil 10 minutes, and strain.

Dose, &c., 1 to 3 fl. oz., 2 or 3 times daily; in phthisis and purulent affections of the urinary organs, unaccompanied with active inflammation; especially in chronic affections of the bladder.

Decoction of Wil'low Bark. *Syn.* DECOCTUM SALICIS, D. S. CORTICIS, L. *Prep.* 1. (*Wilkinson.*) Willow bark (*Salix latifolia*), bruised, $1\frac{1}{2}$ oz.; macerate in water, 2 lbs., for 6 hours, then boil for 15 minutes and strain. Tonic, astringent, and febrifuge.—*Dose.* A wine-glassful.

2. (*Nieman.*) Willow bark (*Salix alba*), $1\frac{1}{2}$ oz.; water, $\frac{3}{4}$ pint; boil to one half.—*Dose,* 1 to 2 fl. oz. Both are used as substitutes for decoction of cinchona bark.

Decoction of Win'ter-green. *Syn.* DECOCTION OF PYROLA, D. OF UMBELLATED WINTER-GREEN, D. OF PIPSISSEWA; DECOCTUM CHIMAPHILÆ (Ph. L.), D. PYROLÆ (Ph. D.), L. *Prep.* 1. (Ph. L.) Chimaphila (dried herb), 1 oz.; water, $1\frac{1}{2}$ pints; boil to a pint and strain.

2. (Ph. D.) Winter-green (dried leaves), $\frac{1}{2}$ oz.; water, $\frac{1}{2}$ pint; boil 10 minutes, in a covered vessel, and strain. Tonic, stomachic, alterative, and diuretic.—*Dose,* 1 to 2 fl. oz.; in dropsies, scrofula, debility, loss of appetite, &c.; and in those affections of the urinary organs in which uva-ursi is commonly given.

Decoction of Worm'seed. *Syn.* DECOCTUM SANTONICI, L. *Prep.* 1. Worm-seed, bruised, 2 oz.; water, 1 pint; boil down to 16 fl. oz. and strain.

2. (*Dr R. E. Griffith.*) Fresh leaves of wormseed (*Chenopodium anthelminticum,* Linn.), 1 oz.; water, 1 pint; orange peel, 2 dr.; boil (10 minutes) and strain. The above are bitter, stomachic, and vermifuge.—*Dose.* A wine-glassful twice a day; in worms. It is also used as an injection against ascarides.

Decoction of Yar'row. *Syn.* DECOCTUM MILLEFOLII, L. *Prep.* From milfoil or yarrow tops, $1\frac{1}{2}$ oz.; water, $1\frac{1}{4}$ pints; boil to a pint, and

strain. Astringent, tonic, and vulnerary.—*Dose.* A wine-glassful thrice daily; in dropsies, &c. It is also used as a fomentation to bruises, &c.

DECOLORA'TION. The blanching or removal of the natural colour of any substance. Syrups and many animal, vegetable, and saline solutions are decolourised or whitened by agitation with animal charcoal, and subsequent subsidence or filtration. Many fluids rapidly lose their natural colour by exposure to light, especially to the direct rays of the sun. In this way castor, nut, poppy, and several other oils are whitened. Fish oils are partially deodorised and decoloured by filtration through animal charcoal. Cottons and linens are still commonly bleached by the joint action of light, air, and moisture. The decoloration of textile fabrics and solid bodies generally is called bleaching. See BLANCHING, BLEACHING, OILS, TALLOW, SUGAR, SYRUPS, &c.

DECOMPOSI''TION (-zĭsh'-un). In *chemistry*, the resolution of compounds into their elements, or the alteration of their chemical constitution in such a manner that new products are formed. For example, chalk (calcium carbonate) when heated is said to be decomposed into quicklime (calcium oxide) and carbonic acid. Also, sulphuric acid is said to be decomposed by zinc, hydrogen being liberated and zinc sulphate formed.

DEFECA'TION. The separation of a liquid from its lees, dregs, or impurities by subsidence and decantation. It is commonly employed for the purification of saline solutions and glutinous or unctuous liquids on the large scale in preference to filtration; than which it is both more expeditious and expensive. See CLARIFICATION, DECANTATION, FILTRATION, &c.

DEFLAGRA'TION. The sudden combustion of any substance by the action of oxygen at a high temperature. The process is commonly performed by projecting into a red-hot crucible, in small portions at a time, a mixture of nitrate of potash and the body to be oxidised.

DELIQUES'CENCE. Spontaneous liquefaction by absorption of moisture from the atmosphere. Deliquescent salts are those which, when exposed to the air, gradually assume the liquid state. They should all be kept in well-closed bottles or jars.

DELIR'IUM TRE'MENS. [L.] The madness of drunkards; a disease of the brain resulting from the excessive and protracted use of intoxicating liquors, particularly of ardent spirits. The early symptoms are extreme irritability and fretfulness, with unusual muscular tremors. Sleeplessness and unpleasant dreams soon follow. At length frightful dreams and visions harass the patient. He sees remarkable sights, hears extraordinary sounds, and labours under all the strange delusions of insane persons, which, however vague and unfounded, operate on him with all the force of realities till he becomes maniacal, and frequently attempts suicide. The pulse quickens and becomes feeble, the general symptoms more marked. In some cases the disease terminates in this stage in a profound sleep; if not, the strength fails, the heart becomes feebler, the tremors increase, the patient never ceases from talking, and picks at the bedclothes; death is ushered in by a short period of calm. The fit almost always comes on after hard drinking; and the hands are usually, but not always, tremulous. A similar affection is occasionally produced by the abuse of opium, excessive mental anxiety, night watching, or depletion. According to Dr Armstrong, even respiring the fumes of ardent spirits will, under some circumstances, produce this disease.

The *treatment* of delirium tremens consists mainly in the judicious use of opium, laudanum, or morphia in rather large doses, frequently repeated. 30 to 60 drops of laudanum may be given every hour or two during the fit, its effects being carefully watched. The object is to produce quiet sleep, from which the patient usually wakes free from the worst symptoms of the disease. Diaphoretics and mild aperients may also be given, and a light, nutritious diet adopted throughout. Depletion, especially bleeding, should be particularly avoided. Alcoholic stimulants and wine, in certain cases, have proved useful. Under this treatment the patient, unless of a very bad habit of body, or much debilitated by previous excesses, usually recovers. He is, however, very liable to relapses and subsequent attacks, which are best prevented by judicious moral management.

The judicious administration of chloral hydrate, in doses of 20 gr., as well as of bromide of potassium in 30-gr. doses, either alone or combined with the chloral, has lately been had recourse to with the happiest results for the production of sleep in cases of delirium tremens or in the insomnia of dipsomaniacs, especially in young subjects.

The repetition of the dose of chloral requires to be regulated with very great caution; and it is only in the case of emigrants and others unable to obtain medical aid that we would recommend it to be given, and then only should opium have failed to produce the desired effect. Not *more* than 60 gr. of the chloral should be administered during the 24 hours. The internal administration of tincture of capsicum in moderately large doses, in the intervals of the opiates or chloral hydrate, has lately been tried in the treatment of this disease, it is said, with success. Mechanical restraint should never be resorted to unless imperatively necessary, and every method of self-destruction must be guarded against, and in all cases the patient should be assiduously watched.

DELPHIN'IC ACID. *Syn.* PHOCE'NIC ACID. A fatty acid, obtained by saponifying the oil of the delphinus or porpoise. According to recent experiments, it is identical with valeric acid.

DELPHIN'INE. *Syn.* DEL'PHINE, DEL'PHIA, DELPHIN'IA. An alkaloid discovered by Lassaigne and Feneulle in *Delphinium staphysagria*, or stavesacre.

Prep. 1. The husked seeds (in powder) are boiled in a little water and pressed in a cloth; a little pure magnesia is then added to the filtered decoction, the whole is boiled for a few minutes and refiltered; the residuum, after being well washed, is digested in boiling alcohol, which dissolves out the alkaloid, and gives it up again by gentle evaporation and cooling.

2. The bruised, but unshelled, seeds are digested

in dilute sulphuric acid, the filtered liquor precipitated with carbonate of potassa, and the precipitate digested in alcohol as before.

3. (*Parrish.*) An alcoholic extract of the seeds is treated with dilute sulphuric acid, precipitated with an alkali, again dissolved in dilute sulphuric acid; the colouring matter precipitated by a few drops of nitric acid, the alkaloid by potassa. The alkaloid is then dissolved in absolute alcohol, and the solution thus formed is evaporated; 1 lb. yields about 1 dr.

Prop., &c. A light yellowish or white, odourless powder; extremely acrid and bitter; scarcely soluble in water; dissolves in ether, and readily in alcohol; and has an alkaline reaction. Its alcoholic solution produces a burning and tingling sensation when rubbed on the skin, and a similar sensation is produced in various parts of the body when it is taken in doses of a few grains. It has been exhibited in neuralgia and rheumatism by Dr Turnbull.—*Dose*, $\frac{1}{12}$ gr. every 3 hours, made into a pill with 1 gr. each of the extracts of henbane and liquorice. It is also used externally under the form of ointment and lotion.

DELPHINUM—a Boot Varnish. Shell-lac, 7·5 grms., dissolved in alcohol, 15 grms., mixed with 20 drops fish oil, and ·1 grm. lamp-black (*Geisse*).

DEMUL'CENTS. In *medicine*, substances which are calculated to soften and lubricate the parts to which they are applied. Though having the same signification as the word EMOLLIENTS, it is desirable to restrict the latter term to such as are intended for external application, and to include under the above head only such as are intended for internal exhibition. The principal demulcents are gum-arabic, gum-tragacanth, liquorice, honey, arrowroot, pearl barley, linseed tea, isinglass, gelatin, milk, almonds, spermaceti, almond and olive oils, and most other mucilaginous, amylaceous, saccharine, and oily substances. For use, these are made into MUCILAGES, DECOCTIONS, EMULSIONS, or MILKS, with water, and form suitable beverages in dysentery, diarrhœa, catarrh, diseases of the urinary organs, and all other diseases where diluents are useful. See EMOLLIENTS.

DENGUE. *Syn.* DANDY FEVER, THREE-DAY FEVER, BREAKBONE FEVER; DENGUE, Fr. and Ger. This disease is most commonly met with in the East and West Indies, and occasionally as an epidemic in America. The symptoms of dengue appear to combine those of rheumatism and scarlet fever. On the third or fourth day an eruption shows itself, accompanied with pains in the limbs, glandular swellings, and languor. The course of the disease is varied by frequent remissions.

DENS'ITY. The density of a substance is the mass of unit volume of that substance. The term is commonly, but erroneously, used as equivalent to SPECIFIC GRAVITY, which is the ratio between the weight of a certain volume of the given substance and the weight of an equal volume of water. Indeed, in the French system of weights and measures, in which the weight of the unit volume of water is taken as the unit of weight, the number expressing the true density of a substance is actually identical with that expressing its specific gravity.

DENT'IFRICES. *Syn.* DENTIFRICIA, L. Substances applied to the teeth to cleanse and beautify them. The most useful form of dentifrices is that of powder (TOOTH POWDER); but liquids (TOOTH WASHES) and electuaries (TOOTH ELECTUARIES, TOOTH PASTES) are also employed. The solid ingredients used in dentifrices should not be so hard or gritty as to injure the enamel of the teeth; nor so soft or adhesive as to adhere to the gums, after rinsing the mouth out with water. Pumice-stone (in fine powder) is one of those substances that acts entirely by mechanical attrition, and is hence an objectionable ingredient in tooth powder intended for daily use. It is, however, very generally present in the various advertised dentifrices, which are remarkable for their rapid action in whitening the teeth. Bath brick is another substance of a similar nature to pumice, and, like that article, should be only occasionally employed. Cuttle-fish bone, coral, and prepared chalk are also commonly used for the same purpose, but the last is rather too soft and absorbent to form the sole ingredient of a tooth powder. Charcoal, which is so very generally employed as a dentifrice, acts partly mechanically and partly by its chemical property of destroying foul smells and arresting putrefaction. For this purpose it should be newly burnt, and kept in well-closed vessels until used, as by exposure to the air it rapidly loses its antiseptic powers. Powdered rhatany, cinchona bark, and catechu are used as astringents, and are very useful in foulness or sponginess of the gums. Myrrh and mastic are employed on account of their odour and their presumed preservative action and power of fixing loose teeth. Insoluble powders have been objected to on account of their being apt to accumulate between the folds of the gums and in the cracks of the teeth, and thus impart a disagreeable appearance to the mouth. To remedy this defect a reddish or flesh-coloured tinge is commonly given to them with a little rose pink, red coral, or similar colouring substance, when any small portion that remains unwashed off is rendered less conspicuous. Some persons employ soluble substances as tooth powders, which are free from the above objection. Thus, sulphate of potash and cream of tartar are used for this purpose, because of the grittiness of their powders and their slight solubility in water. Phosphate of soda and common salt are also frequently employed as dentifrices, and possess the advantage of being readily removed from the mouth by means of a little water. Among those substances that chemically decolour and remove unpleasant odours, the only ones employed as dentifrices are charcoal and the chlorides of lime and soda. The first has been already noticed; the others may be used by brushing the teeth with water to which a very little of their solutions has been added. A very weak solution of chloride of lime is commonly employed by smokers to remove the odour and colour imparted by tobacco to the teeth. Electuaries, made of honey and astringent substances, are frequently employed in diseases of the gums. The juice of the common strawberry has been recommended as an elegant natural dentifrice, as it readily dissolves the tartarous incrustations on the teeth, and imparts an agreeable odour to the

breath. See PASTE and POWDER (Tooth), also WASHES (Mouth).

DENT'INE. The tissue of which the teeth are composed.

DENTISTRY. The art or practice of a dentist. Directions for the extraction of teeth, as well as elaborate details for stopping them, and for the manufacture of artificial ones, are branches of the dentist's art, which, as they necessitate the exercise of considerable skill and long practice, do not call for notice in a work like the present. We shall confine ourselves, therefore, to that section of dentistry which concerns itself with stoppings for the cavities of decayed teeth, and for the preparation of which we give the following formulæ:

1. (*Soubeiran's.*) Powdered mastic and sandarach, of each, 4 dr.; dragon's blood, 2 dr.; opium, 15 gr.; mix with sufficient rectified spirit to form a stiff paste. A solution of mastic, or of mastic and sandarach, in half the quantity of alcohol, is also used, applied with a little cotton or lint.

2. Sandarach, 12 parts; mastic, 6 parts; amber, in powder, 1 part; ether, 6 parts. Applied with cotton. Or simply a paste of powdered mastic and ether. Or a saturated ethereal solution of mastic, applied with cotton.

3. Taveare's cement is made with mastic and burnt alum. Bernoth directs 20 parts of powdered mastic to be digested with 40 parts of ether, and enough powdered alum added to form a stiff paste.

4. Gutta percha, softened by heat, is recommended. Dr Rollfs advises melting a piece of caoutchouc at the end of a wire, and introducing it while warm.

5. (*Gauger's* cement.) Put into a quart bottle 2 oz. of mastic and 3 oz. of absolute alcohol; apply a gentle heat by a water-bath. When dissolved, add 9 oz. of dry balsam of tolu, and again heat gently. A piece of cotton dipped in this viscid solution becomes hard when introduced into the tooth, previously cleansed and dried as above.

6. (*Mr Robinson's.*) After washing out the mouth with warm water containing a few grains of bicarbonate of soda, and cleaning the cavity as above directed, he drops into it a drop of collodion, to which a little morphia has been added, fills the cavity with asbestos and saturates with collodion, placing over all a pledget of blotting-paper.

7. (*Ostermaier's* cement.) Mix 12 parts of dry phosphoric acid with 13 of pure and pulverised quicklime. It becomes moist in mixing, in which state it is introduced into the cavity of the tooth, where it quickly becomes hard. [In some hands this has failed, from what cause we are not aware.] The acid should be prepared as directed under ACID, PHOSPHORIC.

8. (Silica.) This name has been given to a mixture of Paris plaster, levigated porcelain, iron filings, and dregs of tincture of mastic, ground together.

9. (*Wirih's* cement.) It is said to consist of a viscid alcoholic solution of resins, with powdered asbestos.

10. (Metallic cement.) Amalgams for the teeth are made with gold or silver, and quicksilver, the excess of the latter being squeezed out, and the stiff amalgam used warm. Inferior kinds are made with quicksilver and tin or zinc. A popular nostrum of this kind is said to consist of 40 gr. of quicksilver and 20 gr. of fine zinc filings, mixed at the time of using. Mr Evans states that pure tin, with a small portion of cadmium, and sufficient quicksilver, forms the most lasting and least objectionable amalgam. The following is the formula:—Melt 2 parts of tin with 1 of cadmium, run it into ingots, and reduce it to filings. Form these into a fluid amalgam with mercury, and squeeze out the excess of mercury through leather. Work up the solid residue in the hand, and press it into the tooth. Or, melt some beeswax in a pipkin over the fire, throw in 5 parts of cadmium, and, when melted, add 7 or 8 parts of tin in small pieces; pour the melted metals into an iron or wooden box, and shake them till cold, so as to obtain the alloy in a powder. This is mixed with $2\frac{1}{2}$ or 3 times its weight of quicksilver in the palm of the hand, and used as above.

Another cement consists of about 73 parts of silver, 21 of tin, and 6 of zinc, amalgamated with quicksilver. An amalgam of copper is said to be sometimes used. But this class of stoppings is altogether disapproved of by other authorities. Pure leaf-gold seems the least objectionable.

11. (Marmoratum.) Finely levigated glass, mixed with tin amalgam.

12. (Poudre metallique.) The article sold under this name in Paris appears to be an amalgam of silver, mercury, and ammonium, with an excess of mercury, which is pressed out before using it.

13. (Fusible metal.) Melt together 8 parts of bismuth, 5 of lead, 3 of tin, and $1\frac{1}{2}$ or 1·6 of quicksilver, with as little heat as possible (*Chaudet*).

EXPENSIVE METALLIC TOOTH-STOPPING. Take pure gold, pure gelatin, 1 part of each; pure silver, 2 parts; melt, and when refrigerated, reduce to a powder by means of a file; wash well and dry. In the moment of using it add sufficient mercury to form a plastic paste ('Pharm. Journ.').

PASTE FOR DESTROYING THE SENSIBILITY OF THE DENTAL PULP PREVIOUS TO STOPPING. Arsenious acid, 30 gr.; sulphate of morphia, 20 gr.; creosote, q. s. [Unsafe; it is only inserted by way of warning against what may prove an unsuspected cause of mischief.]

PIVOTS FOR ARTIFICIAL TEETH. An alloy of platinum and silver.

SPRINGS FOR ARTIFICIAL TEETH, Equal parts of copper, silver, and palladium (*Chaudet*).

For Cachou Aromatisé, and other compounds for sweetening the breath, see PERFUMERY.

DENTI'TION. See TEETHING.

DEOB'STRUENT. In *medicine*, a substance which removes obstructions, and opens the natural passages of the fluids of the body.

DEODAR (*Cedrus deodara*, Loud.). A large tree widely distributed in the Himalayas from Nepal to Afghanistan, the wood of which is very extensively used in that country on account of its extreme durability for railway sleepers, bridges, &c. It also yields an oil by destructive distillation, which is used in veterinary practice and for other purposes.

DEO'DORISER. Any substance having the power of aborbing or destroying fetid effluvia. Chlorine, chloride of lime, chloride of zinc, nitrate of lead, sulphate of iron, and freshly burnt charcoal, are the most effective and convenient deodorisers. Peat charcoal has been highly recommended for deodorising manure, &c., on the large scale. When it is mixed with these substances their fetor is immediately destroyed, and a compost produced, which may be substituted for guano for agricultural purposes. 'Biedermann's Centralblatt für Agricultur Chemie' for June, 1877, contains the results of some experiments undertaken by A. Eckstein on the comparative deodorising values of certain substances. Herr Eckstein found that 1 kilo. of copperas dissolved in water destroyed the stench in a privy used daily by at least 100 persons. The action ceased after 12 hours. A solution of aqueous sulphate of copper produced a similar result. When 1 kilo. of solid copperas was employed the action lasted for 2 days. The same result was obtained by using 1 kilo. of a mixture compound of copperas, sulphate of copper, and carbonate of lime. Liquid sulphurous acid was found to act very rapidly, rendering the atmosphere difficult to breathe for an hour; its action ceased after 24 hours. Crude carbolic acid, which was used to the extent of 30 grms., gave so unpleasant a smell for 2 days as to render the result impossible to be arrived at. 1 kilo of copperas enclosed in a bag of parchment paper only began to act after 2 hours, and kept the place odourless for 2 days. 1 kilo. of good chloride of lime, placed in a similar bag, did not lose its effect for 9 days. With 60 grms. of permanganate of soda the action commenced immediately, but the effect was over in 24 hours; when enclosed in parchment paper it was efficacious for 2 days. In Herr Eckstein's opinion the most powerful deodoriser known is chloride of lime along with sulphuric acid. Powdered gypsum is a good absorber of ammonia, and for this purpose may be sprinkled over the floors of stables, manure heaps, &c. See DISINFECTANT.

DEOX'IDATION. See REDUCTION.

DEPIL'ATORY. A cosmetic employed to remove superfluous hairs from the human skin. Depilatories act either mechanically (MECHANICAL DEPILATORIES), or chemically (CHEMICAL DEPILATORIES). To the first class belong adhesive plasters, that, on their removal from the skin, bring away the hair with them. The second class includes all those substances which destroy the hair by their chemical action.

Lime or orpiment, and generally both of them, have formed the leading ingredients in depilatories, both in ancient and modern times. The first acts by its well-known causticity, and also, when an alkali is present, by reducing that also, either wholly or in part, to the caustic state. The action of the orpiment is of a less certain character, and its use is even dangerous when applied to a highly sensitive or an abraded surface. The addition of starch is to render the paste more adhesive and manageable.

In using the following preparations, those which are in the state of powder are mixed up with a little warm water to the consistence of a paste, and applied to the part. Sometimes soap lye is used for this purpose, and some persons spread the pulpy mass on a piece of paper, and apply it like a plaster. In 12 or 15 minutes, and sooner, if much smarting ensues, the whole should be washed off with warm water, and a little cold cream, lip-salve, or spermaceti cerate, applied to the part. The application of the liquid preparations is generally accompanied with gentle friction, care being taken to prevent them extending to the adjacent parts. All the following effect the object satisfactorily, with proper management; but some are much more effective than others. A small wooden or bone knife is the best for mixing them with. They must all be kept in well-stoppered bottles, and no liquid must be added to them until shortly before their application; and then no more should be mixed than is required for immediate use.

Depilatory, Arsen'ical. Orpiment (sulphide of arsenic) forms the principal ingredient in many fashionable depilatories, but its use is not free from danger. The following are well-known preparations:

1. (COLLEY'S D.) From nitre and sulphur, of each, 1 part; orpiment, 3 parts; quicklime, 8 parts; soap lees, 32 parts; boil to the consistence of cream. Very caustic.

2. (DELCROIX'S D.; 'POUDRE SUBTILE.') Orpiment, 1 oz.; quicklime, 10 oz.; starch, 14 oz.

3. (ORIENTAL D.; ORIENTAL RUSMA.) *a.* Quicklime, 3 oz.; orpiment, ½ dr.; strong alkaline lye, 1 lb.; boil together in a clean iron vessel until a feather dipped into the liquor loses its flue.

b. From pearlash, 2 oz.; orpiment, 3 dr.; liquor of potassa, ½ pint; boil together as before. One of the most caustic and consequently the most certain of depilatory preparations; but, with the rest of its class, open to the objections of containing orpiment (see No. 7).

4. (PASTE D.; 'PÂTE DÉPILATOIRE.') To No. 1 add of orris root, 3 parts.

5. (PLENCK'S D.; 'PASTA DEPILATORIA.') Orpiment, 1 part; quicklime and starch, of each, 12 parts.

6. (SOAP D.; 'SAVON DÉPILATOIRE.') Turkish depilatory and soft soap, equal parts. Must not be mixed until about to be applied (see No. 7).

7. (TURKISH D.; TURKISH RUSMA.) Orpiment, 1 part; quicklime, 9 parts. For use, it is mixed up with soap lees, and a little powdered starch.

Depilatory, Boettger's. Powdered sulphydrate of sodium, 1 part; washed chalk, 3 parts; made into a thick paste with a little water. Let a layer about the thickness of the back of a knife be spread upon the hairy surface. After 2 or 3 minutes the stoutest hairs are transformed into a soft mass which may be removed by water. A more prolonged action would attack the skin.

Depilatory, Boudet's. *Prep.* Sulphide of sodium (crystallised), 3 parts; quicklime (in fine powder), 10 parts; starch, 10 parts; mix. To be mixed with water, and applied to the skin, and scraped off in 2 or 3 minutes with a wooden knife. Very effective and safe.

Depilatory, Cazenave's. *Syn.* MAHON'S D.; POMMADE DÉPILATOIRE DE CAZENAVE, Fr. *Prep.* Quicklime, 1 part; carbonate of soda, 2 parts; lard, 8 parts; mix. Applied as an ointment.

Depilatory, Chi'nese. *Prep.* 1. Quicklime, 8 oz.; pearlash (dry) and liver of sulphur, of each, 1 oz.; all reduced to a fine powder; mixed, and kept in a close bottle.

2. (ROSEATE D.) As No. 1, but coloured with a little rose pink or light red.

These preparations are applied in the same manner as Boudet's Depilatory.

Depilatory, Colley's. See DEPILATORY, ARSENICAL.

Depilatory, Hydrosulphate of Lime. *Prep.* (*Beasley.*) Mix quicklime and water to a thick cream, and pass into the mixture 25 or 30 times its volume of sulphuretted hydrogen gas. When the gas ceases to be absorbed, stop the process. The pulpy mass is spread on paper, and applied for 12 or 15 minutes. It is very effective, but has a most disgusting smell. Spolasco's depilatory is a very similar preparation (see *below*).

Depilatory, Mechan'ical. *Syn.* DEPILATORY PLASTER. *Prep.* From pitch and resin, equal parts, melted together and spread on leather. Applied as a plaster.

Depilatory, Rayer's. *Prep.* Quicklime, 2 oz.; salt of tartar, 4 oz.; charcoal, $\frac{1}{4}$ oz. Less active than Chinese Depilatory.

Depilatory, Redwood's. *Prep.* A strong solution of sulphide of barium, made into a paste with powdered starch, and applied immediately. Mr Redwood says this is "the best and safest depilatory."

Depilatory, Ro'seate. See DEPILATORY, CHINESE.

Depilatory, Spolasco's. *Prep.* Freshly prepared sulphide of calcium and quicklime, equal parts. Almost equal to Redwood's (*above*).

DEPOSI'TION (of Metals). See ELECTROTYPE.

DERBY CONDITION POWDERS. (*J. Tobias Simpson,* New York.) Celebrated as a safe, infallible, and speedy remedy for glanders, coughs, colds, over-feeding, worms, mouth disease, and loss of horns or hair, in horses and other valuable domestic animals. Tartar emetic, 2 grms.; black antimony, 20 grms.; sulphur, 10 grms.; nitre, 10 grms.; fenugreek, 40 grms.; juniper berries, 20 grms. (*Schädler*).

DER'BYSHIRE NECK. See GOITRE.

DESIC'CANTS. *Syn.* DESICCAN'TIA, L. In *pharmacology,* substances that check secretion and dry sores of abraded surfaces, without acting as styptics, or constringing the fibres of the parts to which they are applied. See ASTRINGENTS.

DESICCA'TION. *Syn.* EXSICCA'TION. The evaporation or drying off of the aqueous portion of solid bodies. Plants and chemical preparations are deprived of their humidity by exposure to the sun, a current of dry air, an atmosphere rendered artifically dry by sulphuric acid, or by the direct application of heat by means of a water-bath, a sand-bath, or a common fire. Planks and timber are now seasoned, on a large scale, in this way, by which a condition may be produced in 2 or 3 days which on the old system is barely attainable in as many years" (*Cooley*).

DESTEM'PER. *Syn.* DISTEMPER. Colours ground up with size, gum, or white of egg, and water, as in scene-painting. The art of executing work in distemper is called 'distemper painting.'

DETER'GENT. An agent having the power of removing offensive matter from the skin. Water, soap, alkalies, ox-gall, milk, vinegar, charcoal, sand, oatmeal, sawdust, pumice, oil, and borax.

Detergent, Collier's. *Prep.* From liquor potassæ, 2 fl. dr.; rose water, $5\frac{1}{2}$ fl. oz.; spirit of rosemary, $\frac{1}{2}$ fl. oz.; mix. One of the best applications known to free the head from scurf, when the hair is strong and healthy. The head should be afterwards sponged with clean, soft water.

DETONA'TION. See FULMINATING COMPOUNDS.

DEUTOX'IDE. See OXIDES.

DEW POINT. The temperature at which dew begins to form, as observed by a thermometer. See METEOROLOGY.

DEXTRIN. $C_6H_{10}O_5$. *Syn.* STARCH GUM, DEXTRINA, DEXTRINUM, BRITISH GUM. A soluble substance resembling gum, formed, together with maltose, by the action of dilute acids at the boiling temperature, and by infusion of malt at about 160° F., on starch. It is also formed when potato-starch and some of the other farinas are exposed to a heat of about 400° F. When further boiled with dilute acids it is converted into dextrose (glucose). See GUM (British).

DEX'TRO-RACE'MIC ACID. See RACEMIC ACID.

DIABE'TES. See URINE.

Diabetes (Saccharine). The symptoms observed in this generally fatal ailment are the passing of an excessive quantity of pale, straw-coloured urine, of high specific gravity, containing more or less grape-sugar; great thirst and hunger, obstinate dyspepsia, constipation; an unpleasant odour from the feet, or perspiration of the arm-pits; and bodily debility and emaciation. All these symptoms vary in intensity according to the course and duration of the disease, which is frequently accompanied with hectic fever, cough, and sometimes carbuncles, and generally ends in some organic disease. The flow of urine sometimes reaches as much as 8 galls. in 24 hours; the average quantity, however, is about 2 galls. The specific gravity of the urine varies between 1030 and 1070. The quantity of sugar excreted in the 24 hours differs greatly, ranging from $\frac{1}{2}$ lb. to 3 lbs.

In the treatment of diabetes, great attention should be paid to diet, which should consist principally of digestible broiled or roasted meat, gluten and bran bread (these latter being substituted for ordinary bread, which with sugar must be especially avoided), liquids in moderate quantity, of which the most preferable are weak beef tea or mutton broth. If the thirst is extreme, it is best assuaged by drinking water acidulated with phosphoric acid. Spirituous liquids as well as saline aperients should be eschewed. Claret is, however, a suitable beverage.

Small doses of laudanum, given 3 or 4 times a day, have been found of great service. The bowels must be regulated by mild aperients. Warm baths are also of use, as they augment the secretion of the skin. The disease may be kept under by administering from 20 to 40 minims of tincture of perchloride of iron, 3 times

a day. The above treatment is inserted for the guidance only of emigrants and others unable to obtain professional aid; wherever this can be obtained, no time should be lost in seeking it. This is the more important, since the earlier the patient has recourse to the proper remedies, the greater are the chances of recovery. The disease is fatal.

Horses. The disease occurs, although rarely, in horses. It is not known either in cattle or dogs. The treatment consists in depriving the animal for some weeks of food containing starch, or other matters capable of forming sugar. He must be fed on meat soup and cooked animal diet, to which he quickly becomes reconciled. The strength must be kept up by means of tonics. To counteract the intense thirst, Mr Finlay Dun recommends the following to be given 3 times a day in water: 1 dr. of iodide of potassium, 1 scruple of iodine, and 4 dr. of carbonate of soda.

DIACHY'LON. See PLASTERS.

DIALY''SER. In *practical chemistry,* an instrument for separating 'crystalloids' from 'colloids,' introduced by the late Prof. Graham. In its most convenient form it consists of a hoop of gutta percha or glass, over which a circular piece of parchment paper is stretched. The paper is applied to the hoop while wet, and is kept stretched by a second hoop, by an elastic band, or by a few turns of string. The instrument, when complete, resembles an ordinary tambourine. It is distinguished as the 'HOOP DIALYSER.' The fluid to be 'dialysed' is poured into the hoop upon the surface of the parchment paper to a small depth only, such as half an inch, and the dialyser is then floated upon water in a large glass basin. Another form of dialyser, termed the 'BULB DIALYSER,' consists of a small glass bell-jar, the mouth of which is covered by a piece of parchment paper. This is suspended or otherwise supported in a large vessel of water in such a manner that the parchment-paper septum just dips below the surface. The simplest form of dialyser is a length of parchment-paper tubing bent into a loop, and the ends perforated to admit a glass rod which will lie across the top of the vessel. See DIALYSIS (*below*), PARCHMENT PAPER.

DIAL'YSIS. In *practical chemistry,* the method of separating substances by 'diffusion' through a septum of gelatinous matter. When a solution having a sp. gr. greater than that of water is introduced into a cylindrical glass vessel, and then water very cautiously poured upon it in such a manner that the two layers of liquid remain unmoved; the substance dissolved in the lower liquid will gradually pass into the supernatant water, though the vessel may have been left undisturbed and the temperature remain unchanged. This process is called the 'diffusion of liquids,' and is quite independent of the densities of the diffusing liquids. From the investigation of the phenomena of this diffusion, the late Prof. Graham derived the remarkable results upon which the method under notice is based. Different substances, when in solution of the same concentration, and under other similar circumstances, diffuse with very unequal velocity. "The range in the degree of diffusive mobility," says Prof. Graham, "exhibited by different substances, appears to be as wide as the scale of vapour-tensions. Thus, hydrate of potash may be said to possess double the velocity of diffusion of sulphate of potash, and sulphate of potash again double the velocity of sugar, alcohol, and sulphate of magnesia. But the substances named belong, as regards diffusion, to the more 'volatile' class. The comparatively 'fixed' class, as regards diffusion, is represented by a different order of chemical substances (marked out by the absence of the power to crystallise), which are slow in the extreme. Among the latter are hydrated silicic acid, hydrated alumina, and other metallic peroxides of the aluminous class when they exist in the soluble form; with starch, dextrine, and the gums, caramel, tannin, albumen, gelatin, vegetable and animal extractive matters. Low diffusibility is not the only property which the bodies last enumerated possess in common. They are distinguished by the gelatinous character of their hydrates. Although often largely soluble in water, they are held in solution by a most feeble force. They appear singularly inert in the capacity of acids and bases, and in all the ordinary chemical relations. But, on the other hand, their peculiar physical aggregation, with the chemical indifference referred to, appears to be required in substances that can intervene in the organic processes of life. The plastic elements of the body are found in this class. As gelatin appears to be its type, it is proposed to designate substances of this class as 'COLLOIDS,' and to speak of their peculiar form as the 'colloidal condition of matter.' Opposed to the colloidal is the 'crystalline condition.' Substances affecting the latter form will be classed as 'CRYSTAL'LOIDS.' The distinction is, no doubt, one of intimate molecular constitution" ('Philosoph. Trans.' for 1861). "A certain property of colloidal substances comes into play most opportunely in assisting diffusive preparations. The jelly of starch, that of animal mucus, of pectin, of vegetable gelose, and other solid colloidal hydrates, all of which, strictly speaking, are insoluble in cold water, are themselves permeable when in mass, as water is, by the more highly diffusive class of substances. But such jellies greatly resist the passage of the less diffusible substances, and cut off entirely other colloid substances like themselves that may be in solution. A mere film of the jelly has the separating effect." Now, parchment-paper, when wetted, acts just like a layer of animal mucus or other hydrated colloid by permitting the passage of crystalloids, but not of colloids; consequently this substance may be used for dialytic septa (see DIALYSER, *above*). The following experiments recorded by Graham will give some idea of the results which may be obtained by dialysis:

1. Half a litre of urine was placed in a hoop dialyser, which was then floated on a considerable quantity of pure water. Dialysed for 24 hours, the urine gave its crystalloidal constituents to the external water. The latter, evaporated by a water-bath, yielded a white saline mass. From this mass urea was extracted by alcohol in so pure a condition as to appear in crystalline tufts upon the evaporation of the alcohol.

2. By pouring silicate of soda into diluted hydrochloric acid (the acid being maintained in large excess), a solution of silica is obtained. But in addition to hydrochloric acid, such a solution contains chloride of sodium, a salt which causes the silica to gelatinise when the solution is heated, and otherwise modifies its properties. Now, such a solution placed for 24 hours in a dialyser of parchment paper was found to lose 5% of its silicic acid (silica) and 86% of its hydrochloric acid. After 4 days on the dialyser, the liquid ceased to be disturbed by nitrate of silver. All the chlorides were gone, with no further loss of silica. What remained was a pure solution of silicic acid, which could be boiled in a flask and considerably concentrated without change.

3. Half a litre of dark-coloured porter, with ·05 grm. of arsenious acid added (1-10,000th part of arsenious acid) was placed on a hoop dialyser 8 in. in diameter, and the whole floated in an earthenware basin containing 2 or 3 litres of water. After 24 hours the latter fluid had acquired a slight tinge of yellow. It yielded, when concentrated and precipitated by sulphuretted hydrogen, upwards of one half of the original arsenious acid in a fit state for examination.

This process is extremely useful in cases of suspected poisoning by arsenic, &c.; the contents of the stomach may be dialysed, when the arsenic will pass through the parchment membrane, leaving the remains of food, mucus, &c. behind.

DIAMANTKITT—Diamond Cement. Fifty parts graphite, 15 parts litharge, 10 parts milk lime, 5 parts slaked lime, intimately mixed with enough linseed oil to make a firm mass (*Hager*).

DIAMOND. The diamond is one of the 'allotropic' modifications of carbon, of which it almost entirely consists; it burns when heated to a high temperature, forming carbon dioxide CO_2, and leaving a very small quantity of ash. It is usually colourless, but is found sometimes of a yellow, green, blue or black tint, the colours being due to mineral matter. Its specific gravity is 3·4. It is one of the hardest bodies known. It crystallises in cubes or in octahedra with convex faces, and rounded edges. It has a very high refracting power, which causes its magnificent glittering appearance. Great care and skill are needed in cutting the diamond for ornamental purposes; it is cut in three forms, the brilliant, the rose, and tables, of which the brilliant is most esteemed. The diamond is found in India, Brazil, the Ural mountains, Australia, and Africa. The largest undoubted diamond is the Orloff, in the sceptre of the Emperor of Russia, weighing 194¾ carats, and cut in the rose form; next come the Pitt diamond, 136¾ carats; the Florentine, 139½ carats; and the Koh-i-Noor, 106 carats.

Economic Uses. The use of the diamond is very important in cutting glass, polishing gems and other hard bodies, and for boring machines used in forming tunnels, and artesian wells. In the glazier's diamond, the curvature of the fracture faces gives a sharp edge that cuts, and not scratches merely. For polishing purposes, imperfect diamonds are broken up and crushed into diamond powder.

Formation. This is at present not at all understood; many attempts have been made to produce artificial diamonds, but without success. Minute artificial diamonds have, however, been made by the crystallisation of carbon from molten silver.

Value of Diamonds. The weight, and, consequently, the value of diamonds is estimated in carats, one of which is equal to 4 gr.; and the price of one diamond compared to that of another of equal colour, transparency, purity, form, &c., is as the squares of the respective weights. The average price of ROUGH DIAMONDS that are worth working is about £2 for the first carat; that of a CUT DIAMOND is equal to that of a rough diamond of double weight, exclusive of the price of workmanship. "To estimate the value of a wrought diamond, ascertain its weight in carats, double that weight, and multiply the square of this product by £2" (*Ure*). Thus, a cut diamond of

1 carat	is worth	£8
2 carats	„	32
3 „	„	72
4 „	„	128

&c. See CARBON, GEMS.

THE LARGEST BRILLIANT IN THE WORLD. Concerning the early history of this South African gem very little is known; in fact, where the stone was found is only a matter of conjecture. It is, however, believed that it was found in one of the Kimberley mines, South Africa. It was decided to cut it into the largest possible brilliant, still preserving a good shape. The stone in its finished condition weighs 180 carats, is a beautiful, perfect steel-blue diamond, and is the largest brilliant in the world. It is 39·5 mm. (1 9-16th in.) long, 30 mm. (1 11-64th in.) wide, and 23 mm. (15-16th in.) thick, being exceeded in size by one diamond only, the Orloff. The original weight of the stone was 457½ carats, 3 1-60th oz. troy.

DIAPEN'TE. *Syn.* PULVIS DIAPENTE. *Prep.* 1. (Ph. E. 1744.) Bay-berries, birthwort, gentian, ivory dust, and myrrh, equal parts. An excellent warm tonic, especially useful in the debility and rickets of children. The substance sold under this name in the shops is an inferior mixture, used principally as a tonic in veterinary practice. The following are the forms commonly adopted in its preparation:

2. Turmeric, 4 lbs.; laurel berries and mustard, of each, 3 lbs.; gentian, 2 lbs. (all in fine powdow); mix.

3. Bay-berries, gentian, mustard, and turmeric, equal parts.

4. Gentian, 6 lbs.; bay-berries, 1 lb. This is the formula generally used by the farriers. Sometimes mustard, 1 lb., is added.

DIAPHORET'ICS. *Syn.* SUDORIF'ICS; DIAPHORETICA, SUDORIFICA, L. Medicines which promote or increase the perspiration. Those that produce this effect in a very marked degree are more particularly called 'sudorifics.' The principal diaphoretics are: warm diluents, as barley-water, gruel, tea, &c.; salts of the alkalies, as the citrates of potassa and soda, acetate of potassa, acetate and carbonate of ammonia, sal-ammoniac, nitre, &c.; preparations of antimony, as antimonial powder, tartar emetic, &c.; also alcohol,

camphor, Dover's powder, ipecacuanha, opium, wine, &c.

The use of diaphoretics is indicated in nearly all diseases accompanied by fever and a dry skin, and particularly in febrile and pectoral affections.

DI'APHRAGM (-frăm). A partition through or across; a dividing substance. In *anatomy*, the term is applied to the midriff, a muscle separating the chest or thorax from the abdomen or lower belly. In *astronomy* and *optics*, the term is applied to a circular ring placed in a telescope or other instrument to cut off the marginal portions of a beam of light. In *electricity*, the name is commonly used to denote the porous partition cell, or vessel, that separates the fluid containing the positive plate from the fluid which surrounds the negative plate, in a constant voltaic battery. Thin partitions of sycamore, or other porous wood, are occasionally used, but cells made of thin biscuit-ware are the most convenient and durable diaphragms. Plaster of Paris, animal membrane, coarse and tightly wove canvas, &c., are used also for the purpose. Plaster cells are also formed by surrounding an oiled cylinder of wood with a hoop of paper, and pouring plaster of Paris, mixed up with water, into the space between the two. See ELECTROTYPE, MICROSCOPE, PHOTOGRAPHY.

DIARRHŒ'A. A purging or looseness of the bowels. The causes of diarrhœa are various, but among the most common are the presence of irritating matter, worms, or acidity in the stomach or bowels; and exposure to cold (especially cold to the feet) or sudden changes of climate or temperature.

Treatm. In general, it will be proper to administer a mild aperient, for which purpose rhubarb or castor oil is usually preferred. The dose of the first may be from 20 to 30 gr. in sugar, or made into a bolus; that of the second, from ¼ oz. to ½ oz., with a little mint or peppermint water. After the due operation of this medicine, opium, astringents, and absorbents may be taken with advantage, but not in excessive doses, as is commonly the practice. The first and second are indicated when great irritability exists, and the third in cases of diarrhœa arising from the presence of acidity. Chalk mixture, to which a few drops of laudanum have been added, or the compound powder of chalk and opium, are excellent medicines, and will generally quiet the bowels.

In bilious diarrhœa, characterised by the bright yellowish-brown colour of the dejections, a dose of blue pill or calomel, assisted by mild diluents and demulcents, and warmth generally proves efficacious. Small doses of opium are also useful in some cases.

In catarrhal diarrhœa, chylous diarrhœa, and the like varieties, characterised by the dejections being nearly colourless, and consisting chiefly of water and mucus; or white and milky, showing the entire absence of bile; or, being entirely liquid, limpid, and serous (in some cases resembling the washings of flesh), opinions are divided as to the treatment. The majority of the best authorities regard purging as injurious in these varieties, and rely chiefly on warm baths and warm fomentations, with the internal administration of mild salines and diaphoretics, followed by astringents, tonics, and occasional doses of opiates. Choleraic diarrhœa demands a nearly similar treatment.

The diet in every variety of diarrhœa should be light and non-irritating. Glutinous broths, beef tea, and arrowroot are among the best articles which can be taken. To these may be added a little dry toast. Arrowroot (genuine), either with or without a spoonful of port wine or brandy (preferably the former), will of itself cure most ordinary cases of diarrhœa, if accompanied with repose and a recumbent posture.

Among external remedies, warm and stimulating fomentations, liniments, &c., to the epigastrium and abdomen, will be found useful adjuncts to other treatment. A spoonful or two of laudanum, used as a friction, will generally allay pain, and in many cases settle the bowels when all other remedies have been tried in vain.

Treatm. for Animals. If for the horse, give at the commencement of the attack a full dose of aloes, 6 to 8 dr., mixed with 1 oz. of bicarbonate of soda, and the same quantity of ginger in powder; administer clysters occasionally. Cattle may be treated by having administered to them ¾ lb. of Epsom or common salt, or a pint of linseed oil. Whichever of the two is employed, it must be combined with 2 oz. each of bicarbonate of soda and ginger, and ½ lb. of treacle; 1 oz. of laudanum should be added to the above drenches whenever there is much pain and straining, whether in the horse or cow. Should laxatives fail, aromatics and astringents are called for, and 1 oz. each of tincture of catechu, ginger, and gentian, given in a pint of warm ale, may be tried several times a day for a horse. For cows a double dose is required. Sheep need only half the dose. The food should be light and easily digested, and the quantity of fluid restricted.

DIASTASE. A substance, contained in malt, which effects the conversion of starch, first into dextrin, and then into maltose-sugar. It contains nitrogen and a small quantity of sulphur.

Prep. Green barley malt is digested with dilute alcohol (20%) for 24 hours; the extract is precipitated with 2½ vols. of absolute alcohol, and the precipitate washed with alcohol and ether. It may be purified by repeated solution in water and precipitation with alcohol, and also by dialysis.

Prop., &c. Diastase seems to resemble vegetable albumen, but very little is known respecting it, as it has never been obtained in a state of purity. One part of diastase is capable of converting 2000 parts of starch into grape-sugar. Malted barley is said to contain 1-500th part of this substance; yet this small portion is quite sufficient to convert the starch of the malt into sugar during the operation of mashing in the manufacture of beer. See BREWING, DEXTRIN, &c.

DICHOPSIS GUTTO, Benth. A tree of 40 ft. high, native of Malacca, Singapore, Sumatra, &c. Yielding gutta percha, q. v.

DICTA'MIA. A nutritious, dietetic article. *Prep.* (*Beasley.*) Sugar, 7 oz.; potato arrowroot, 4 oz.; flour of Brent barley (*Triticum mono-*

coccum), 3 oz.; Trinidad and Granada chocolate, of each, 1 oz.; vanilla, 15 gr.; triturate together.

Dictamia. A strengthening and restorative preparation. Arrowroot, 6 parts; meal of *Triticum monococcum*, 6 parts; chocolate, 4 parts; vanilla, $\frac{1}{4}$ part (*Richter*). Sugar, 217 parts; bran extract, 92 parts; starch 125 parts; Caracas and Maragnan cocoa, 30 parts; vanilla, 1 part (*Chevallier*).

DIDYM'IUM. Di. A rare metal, found associated with cerium and lanthanium in the Swedish mineral cerite. See CERIUM.

DI'ET. Food or victuals. In *medicine*, food regulated by certain rules, or prescribed for the cure or prevention of disease. The dietetic part of medicine is no inconsiderable branch, and deserves a much greater share of regard than it commonly meets with. A great variety of diseases might be removed by the observance of a proper diet and regimen, without the assistance of medicine, were it not for the impatience of the sufferers.

Writers on dietetics (DIETETICA, L.) have taken much trouble to divide and classify the numerous articles of food suitable to the various conditions of the body in health and disease; but little practical advantage has resulted from their labours. Low diet, middle diet, full diet, milk diet, farinaceous diet, fruit diet, and vegetable diet are terms which, under most circumstances, are sufficiently simple to be almost self-explanatory.

DIGES'TION. In *chemistry* and *pharmacy*, the operation of exposing bodies to a gentle and continuous heat. The best digesters are thin glass flasks and beakers, and the most convenient source of heat is the sand-bath. Digestion is often performed to soften and otherwise modify bodies that are to be distilled. In *physiology*, the term is applied to the conversion of food into chyme, or the process of dissolving food in the alimentary canal, and preparing it for circulation and nourishment. In *surgery*, digestion signifies a method of treating ulcers, wounds, &c. See DIGESTIVES (*below*).

Digestive Ferments. These are a class of agents intended to supply the place of the normal secretions which take part in the digestion of food. They may be roughly classed under two heads:

1. Those most active in acid medium—pepsin and the milk-curdling ferment of rennet.

2. Those most active in an alkaline medium—trypsin, ptyalin, diastase, and the milk-curdling principle of the pancreas.

None of these have been isolated in a state of complete purity, but by the action of solvents (as glycerine) on the mucous membrane of stomachs an active fluid preparation can be made; and also by precipitating the aqueous extract of the minced pancreas with strong alcohol an exceedingly active powder is obtained, containing both the amylolitic and proteolytic ferments of the pancreas.

It is important that the activity of all these preparations be tested by their digestive action on starch or white of egg, since ferments are not always present in a perfect condition in all crude material. See FOOD.

Digestibility of Different Foods.

The results recorded in the following table, giving the respective time required for the digestion of different foods, were obtained by Dr Beaumont, through his being enabled to watch the process of digestion actually going on in the stomach of a man who had received a wound in that organ.

Foods.	How cooked.	Mean time of chymification in stomach. h.	m.
Rice	Boiled	1	
Eggs, whipped	Raw	1	30
Trout, salmon, fresh	Boiled	1	30
Venison, steak	Broiled	1	35
Sago	Boiled	1	45
Milk	Boiled	2	
Eggs, Fresh	Raw	2	
Milk	Raw	2	15
Turkey	Boiled	2	25
Gelatin	Boiled	2	30
Goose, wild	Roasted	2	30
Pig, sucking	Roasted	2	30
Lamb, fresh	Broiled	2	30
Beans, pod	Boiled	2	30
Potatoes, Irish	Baked	2	30
Chicken	Fricasseed	2	45
Oysters, fresh	Raw	2	55
Eggs, fresh	Soft-boiled	3	
Beef, lean, rare	Roasted	3	
Mutton, fresh	Boiled	3	
Bread, corn	Baked	3	15
Butter	Melted	3	30
Cheese, old, strong	Raw	3	30
Potatoes, Irish	Boiled	3	30
Beef	Fried	4	
Veal, fresh	Broiled	4	
Fowls, domestic	Roasted	4	
Ducks, domestic	Roasted	4	
Veal, fresh	Fried	4	30
Cabbage	Boiled	4	30
Pork, fat and lean	Roasted	5	15

The above data were controlled by a series of independent experiments, which consisted in digesting different foods in a solution of gastric juice, and heating the mixture to 100° F. The value of the table is perhaps somewhat doubtful.

DIGES'TIVES. In *surgery*, substances which, when applied to wounds or tumours, induce or promote suppuration. All stimulating applications are of this class. Heat is a most powerful digestive agent. The action of digestives is opposed to that of DISCUTIENTS, which repel or resolve tumours and indurations.

DIGITALEIN. (*Schmiedeberg.*) An amorphous glucoside from digitalis. Freely soluble in water. Has the same action as digitalin, but said to be non-cumulative.—*Dose*, $\frac{1}{100}$ gr.

DIGITA'LIN. $C_{27}H_{45}O_{15}$. *Syn.* DIGITA'LIA. A glucoside obtained from *Digitalis purpurea*, or purple foxglove.

Prep. 1. (*Majendie.*) Foxglove leaves (powdered), 1 lb., are digested in ether, first in the cold, and then heated under pressure; when the whole has again become cold, the liquor is filtered (rapidly), and the ether is distilled off in a water-bath; the residuum is dissolved in water, the filtered solution treated with hydrated oxide of lead, the whole gently evaporated to dryness, and the dry residuum again digested in hot ether; from this solution the alkali is obtained, by eva-

poration and repeated re-solutions, in a crystalline form.

2. (*Homolle and Henry.*) Foxglove leaves (carefully dried and powdered), $2\frac{1}{2}$ lbs., are digested in rectified spirit, and the tincture expressed in a tincture press; the spirit is then distilled off, and the residual extract treated with distilled water, $\frac{1}{2}$ pint, acidulated with about 2 fl. dr. of acetic acid, a gentle heat being employed; some animal charcoal is then added, and the whole filtered; the filtrate is then diluted with water, and partly neutralised with ammonia; a fresh-made strong decoction of galls is next added; a copious precipitation of tannate of digitalin ensues; the precipitate is washed with water, and mixed with a little alcohol (after which it is triturated with litharge (in fine powder), and exposed to a gentle heat; the whole is now digested in alcohol, the tincture treated with animal charcoal and evaporated; the dry residuum is, lastly, treated with cold sulphuric ether, which takes up some foreign matter, and leaves the digitalin. 2 lbs. 8 oz. of the dried leaves yield 140 to 150 gr. of the digitalin.

Prop., &c. White, inodorous, porous masses, or small scales; it crystallises with difficulty, is intensely bitter, and excites violent sneezing when smelled; dissolves freely in alcohol; scarcely soluble in cold ether; and takes 2000 parts of water for its solution; it is neither basic nor alkaline; concentrated colourless hydrochloric acid dissolves it, forming a characteristic solution which passes from yellow to a fine green (*Homolle.*) It is one of the most powerful of known poisons, being fully 100 times stronger than the powdered leaves of the dried plant. It is used in the same cases.—*Dose,* $\frac{1}{60}$ to $\frac{1}{30}$ gr.; either made into pills or dissolved in alcohol and formed into a mixture. Owing to the difficulty and uncertainty connected with dispensing such small quantities, it is now seldom employed in this country.

Digitalin, Crystallised. Digitalis leaves from the Vosges, in rather fine powder, 1000 grms.; neutral lead acetate, 250 grms.; distilled water, 1000 grms. The digitalis should be collected in its second year, just when the first flowers appear. With respect to the lead acetate, it is very important that it should not have an alkaline reaction; a slight acidity would be preferable. The lead salt is dissolved in the cold water, the powder added and thoroughly mixed, the whole passed through a sieve and left in contact 24 hours, taking care to mix it from time to time. The mixture is then packed sufficiently in a displacement apparatus, and exhausted with 50% alcohol, until it no longer yields any bitterness. About 6 parts of liquor are thus obtained, and this is neutralised exactly with sodium bicarbonate dissolved to saturation in cold water; about 25 to 30 grms. will be required. When effervescence ceases, the alcohol is distilled, and the liquor remaining is evaporated in a water-bath down to 2000 grms.; it is then left to cool and diluted with its weight of water. Two or 3 days afterwards the clear liquor is decanted off, by means of a syphon, and the precipitate drained upon a linen filter. When freed from the extractive liquor the precipitate weighs about 100 grms. It is suspended in 1000 grms. of 80% alcohol, and the whole passed through a metal sieve or a fine cloth; the turbid liquor obtained is heated to ebullition, and to it is added a solution containing 10 grms. of neutral lead acetate; the heating is continued a few moments, and the liquor is then left to cool and filtered. The deposit in the filter is washed with alcohol to remove any liquor it may retain, and then pressed. To this liquor is added 50 grms. of finely powdered vegetable charcoal that has been washed with acid and afterwards with water until quite neutral, and it is then distilled, the residue being heated for some time in a water-bath, it being very important that all the alcohol should be driven off. A little water is added to replace what may evaporate; the residue is allowed to cool, then drained upon the cloth that was used to separate the precipitate, and the carbonaceous mass is washed with a little water to remove the last portion of the coloured liquor. The carbonaceous residue is then dried completely in a stove at a temperature not exceeding 100° C., and exhausted by displacement with pure chloroform until it passes colourless. This liquid is distilled to dryness, and a few grms. of 95% alcohol are placed in the retort, and evaporated to drive off the last traces of chloroform.

The residue is crude digitalin with viscous and oily matter. It is dissolved with heat in 100 grms. of 90% alcohol, and 1 grm. of neutral lead acetate dissolved in a little water added, together with 10 grms. of animal charcoal in fine granules without powder that has been treated with hydrochloric acid, and washed until the washings are no longer acid. After boiling for 10 minutes it is allowed to cool and settle, and then filtered in a glass cylinder furnished with a tight cotton plug, through which it passes quickly and clear. The black deposit is added last, and exhausted of all bitterness with alcohol. After distillation the digitalin remains as a grumous crystalline mass, now only contaminated with the coloured oil. A little aqueous liquor that occurs with it is separated, and the weight of the impure digitalin is taken in the previously tarred vessel. The digitalin is then dissolved with heat in exactly sufficient 90% alcohol for its solution (from 6 to 12 grms.). Any alcohol evaporated is replaced, and then to the cooled solution is added, sulphuric ether rectified at 65°, to half the weight of the alcohol employed; after mixing, distilled water equal to the weight of the alcohol and ether combined is added, and the flask is closed and shaken. Two layers are formed: the upper is coloured, and consists of the ether which has taken up the fat oil; the lower is colourless, and contains the digitalin, which, being now free, quickly crystallises. The flask is placed in a cool place. Two days afterwards the whole is thrown into a small cylinder furnished with a moderately tight cotton plug; the mother liquor runs off, and then the coloured layer, and the small quantity that remains adherent to the crystals, is removed by a little ether. Thus obtained, this first crystallisation of digitalin is slightly coloured; it is sufficiently pure, however, for its weight to be taken in an analysis; 1-10th being deducted for the digitin it still

contains. To obtain it perfectly white, two purifications are necessary, but first a treatment with chloroform is indispensable to separate the remainder of the digitin which injures its purity.

The digitalin, well dried and reduced to a fine powder, is dissolved in 20 parts of chloroform, and the solution is filtered in a cylinder through a tight cotton plug. The liquor passes limpid; it is distilled to dryness, and a little alcohol is poured into the retort, and evaporated to reremove the last traces of chloroform.

The digitalin is dissolved in 30 grms. of 90% alcohol, 5 grms. of washed granular animal black added, and the whole boiled for 10 minutes; the liquor is filtered and the charcoal exhausted as before indicated; and, lastly, it is distilled, the digitalin in dry crystals is found on the sides of the vessel, but it is still slightly coloured. To obtain it perfectly white it is dissolved with heat in exactly sufficient 90% alcohol (about 6 to 8 grms.); to the solution is added ether equal to half the weight of alcohol employed and double the quantity of distilled water, and the flask is closed and agitated; the crystallisation commences quickly. The ether does not separate. It is exposed to the coolness of the night, and by the next day nearly the whole of the digitalin is deposited in small groups of white needles, that which retains colouring matter remaining in the mother liquor. The whole is thrown into a cylinder, and the crystals washed with ether as before described. 1000 grms. of Vosges digitalis of good quality yields about 1 grm. of crystallised digitalin. Digitalin occurs under the form of very white light crystals, consisting of short slender needles, grouped around the same axis. It is very bitter, and scarcely soluble in water. 90% alcohol dissolves it well, anhydrous alcohol dissolves it less freely. Pure ether dissolves only traces. Chloroform is its best solvent. Brought into contact with a small quantity of hydrochloric acid, digitalin is coloured emerald green, and this reaction is favoured by a very slight heat. From 'Formulæ for New Medicaments, adopted by the Paris Pharmaceutical Society.'

DIGITOXIN. (*Schmiedeberg.*) A glucoside, and the most poisonous principle of digitalis, being cumulative. It is insoluble in water, but crystallises from alcohol.

DIKA BREAD. Made from the seeds of *Irvingia Barteri*, Hook. f., a good sized tree, a native of West Tropical Africa. The seeds contain a quantity of oil or fat similar to cocoa butter, and is used by the natives in cooking.

DIKAMALI. The greenish-yellow resin of *Gardenia lucida*, Roxb. The odour is peculiar and offensive like that of cat's urine. Used in India as a remedy for dyspepsia.

DILL. *Syn.* ANETHUM (Ph. L. & E.), L. The fruit (seed) of *Anethum graveolens*, or garden dill, *Anethi fructus*, (B. P.). Dill is an aromatic stimulant and carminative. The Cossacks employ it as a condiment; and in this country it is frequently employed to heighten the relish of soups and pickles, especially cucumbers. DILL WATER is a favourite remedy of nurses to promote the secretion of milk and to relieve the flatulence and griping of infants.—*Dose.* Of the powder, 10 gr. to ½ dr., or more. Oil of dill (OLEUM ANETHI) and dill water (AQUA ANETHI) are officinal in the pharmacopœias.

DILOPHUS VULGARIS. The Hop-cone Fly, Fever Fly. This is one of the numerous species of *Tipulidæ*, of the sub-family *Bibionides*, according to Westwood. Several of these species do much injury to plants both in their larval state, in which they bear more or less resemblance to the larvæ of the common Daddy Longlegs, and in their winged state. According to Taschenberg asparagus, ranunculi, barley, rye, and other plants are attacked by different species. Curtis speaks of this larva as injuring potatoes. The larvæ of the *Dilophus vulgaris* were found in hop-roots in Kent; and the flies were found in hop-cones at Rainham, in Kent, towards the end of August. Hop-cones were sent to the writer from the neighbourhood of Maidstone full of these flies, which had evidently much injured the cones. The male fly is black and smaller than the female, whose colour is rather lighter. This fly sometimes appears in large swarms; and upon the Norfolk coast in 1862 it was recorded as hanging in millions on flowers, and in bunches on grasses.

Prevention. It is supposed by Curtis that the eggs of this fly are laid in manure. In this case the grubs or larvæ are taken with the manure close to the roots of the hop-plants. Manure heaps or mixens lying in the neighbourhood of recent attacks, or where flies have appeared, should be carefully turned and treated with lime.

Remedies. When it is ascertained that the grubs or larvæ of the hop-cone fly are doing mischief to the plant-centres, dressings of lime, soot, lime ashes, or of sawdust or ashes steeped in paraffin oil should be put as closely as possible round them. It is important to prevent the development of the flies, as there is no remedial measure that can be applied when these have established themselves in the cones ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

DIL'UENTS. *Syn.* DILUENTIA, L. *Aqueous liquors;* so named because they increase the fluid portion of the blood. Tea, barley-water, water-gruel, and similar articles, are the most common diluents, after pure water. The copious use of diluents is recommended in all acute inflammatory diseases not of a congestive character, and to promote the action of diuretics and sudorifics.

DIMORPHANDRA MORA, Bth. (*Mora excelsa*, Bth.). A tree 100 to 150 feet high, and frequently unbranched for nearly half the height; native of British Guiana. The trunk is often from 2 feet to 2½ feet in diameter. The wood is extremely hard and durable, and considered first-class for ship-building. The seeds, which are very large, are eaten by the natives in times of scarcity.

Dimorphandra Oleifera, Triana, from Rio Grande, Panama. The fruit of this tree has probably the largest embryo in the vegetable kingdom. One in the Kew Museum measures 14 inches round and 6½ inches in the widest part.

DINNER PILLS. See PILLS.

DIOS'MA. *Syn.* BOOKOO, BUKU; FOLIA BAROSMÆ, F. DIOSMÆ, L.; BUCHU (Ph. L.), BUCKU (Ph. E.), DIOSMA (Ph. L. 1836). "The leaves of *Barosma serratifolia*, *B. crenulata*, and

B. betulina" (Ph. Br.). These species were all included by De Candolle in the genus *Diosma*. Buchu is principally employed in chronic affections of the urino-genital organs, especially that of the mucous membrane of the bladder, attended with copious discharge of mucus.—*Dose*, 20 gr. to ½ dr. of the powder, taken in wine; or made into an infusion or decoction.

The officinal buchu leaves are "glabrous, glandular; either linear-lanceolate with small serrations, or ovato-oblong, obtuse, crenated, ovate or obovate, serrated." (Ph. Br.) Their odour somewhat resembles that of rue, and their taste is warm and mint-like. By distillation they yield a volatile substance known as barosma camphor. It is the odorous principle and a stearoptene.

DIOS'MINE. A bitter extractive matter, obtained by Brande from buchu leaves. It is very soluble in water, but not in alcohol and ether.

DIOSPYROS KAKI, Lin. fil. The Chinese date plum. The fruits are edible, and are used by the Chinese both in the fresh and dried states. The plant has lately been introduced into European gardens.

Diospyros quæsita, Thw. Calamander or Coromandel wood—now become extremely scarce. Affords a most beautiful cabinet wood, taking a high polish; it is so hard that edge tools can scarcely work it.

Diospyros virginiana, Linn. The Persimmon. A tree common in the middle and Southern States of North America. The fruit has a strong astringent taste, and is hence used medicinally; when fully ripe or bletted it is edible. From the unripe fruit an indelible ink is made in the Southern States. The bark is bitter and a febrifuge; the wood is dark coloured and hard, and has recently been used in this country for weaving-shuttles.

The woods and fruits of several species of *Diospyros, D. ramiflora*, Roxb., *D. melanoxylon*, Roxb., and *D. ehretioides*, Wall., from the East Indies, and *D. mespiliformis*, Hochst., from tropical Africa, are used for various purposes. The fruit of *D. lotus*, Linn., a native of Italy and the East, is used as a remedy for diarrhœa.

DIPHTHERIA. A contagious disease affecting the throat and adjoining parts. A false membrane forms on the mucous lining of the several parts of the throat. This alarming malady generally commences with a little soreness of the throat attended with fever; sometimes, however, the fever may not come on for some days after the sore throat has shown itself. An ash-coloured spot makes its appearance on one or both tonsils. This spreads to other parts, extending, in doing so, over the soft palate and uvula, inclosing the latter in a sheath. Sometimes a thin red line surrounds the opaque membrane thus formed. As the disease proceeds this opaque and false membrane tends to enlarge itself, and may spread down the gullet into the stomach, or, what is more dangerous still, it may involve the mucous membrane of the larynx, and thence extend along the windpipe into the bronchial tubes. When this is the case the disease is accompanied with cough, and the peculiar noise of croup—harsh, noisy breathing. There also frequently runs from the nostrils a thin acrid secretion, smelling very offensively, and often tainting the whole atmosphere of the room.

By the inexperienced diphtheria is almost always mistaken for ulcerated sore throat.

As in croup, part of the exudation or false membrane is often coughed up; sometimes it peels off from the tonsils. Minute particles of this membrane, loosely adhering to drinking vessels, linen, sheets, the night-dress, &c., of the patient, may be the means of communicating the disease; and the necessity of thoroughly cleansing and disinfecting everything with which the secretions of the patient come into contact cannot be too strongly insisted upon.

The foregoing has been written with the object of enabling the reader to detect the only symptoms by which this dangerous disease manifests itself, in order that he may seek medical assistance with which to combat the complaint as promptly as possible.

Cleanliness, fresh air in abundance, but without draughts; good nourishing food with stimulants, administered *per anum* if the patient cannot retain food in the stomach, constitute the general treatment of the disease. Individual symptoms require medical advice.

Emetics should be used with great care, and only ipecacuanha and zinc sulphate are admissible.

DISCU'TIENTS. In *surgery*, substances or agents which disperse or resolve tumours, &c. See Digestives.

DISH-COVERS. As these are made of various materials, they must be cleaned and polished with the substances best adapted for each. All kinds of dish-covers directly they come from table should be washed free from grease and wiped dry.

Plated and silver dish-covers should be polished with plate powder; that free from mercury should be preferred. When dish-covers (as is usually the case) are made of block tin, they should be polished by first rubbing them with sweet oil, and then dusting over the oil finely powdered whiting; finishing off the polishing with soft rags. All the best covers are provided with movable handles, which must be removed during the process of cleaning.

DISINFECT'ANT. An agent which absorbs, neutralises, or destroys putrescent effluvia, miasmata, or specific contagia, and thus removes the causes of infection. The principal disinfectants are chlorine, iodine, bromine, the so-called chlorides of lime and soda, chloride of zinc, ozone, carbolic acid, the alkaline manganates and permanganates, peat charcoal, the fumes of nitric, nitrous, and sulphurous acids, heat, and ventilation. The last two are the most efficient and easily applied. The clothing, bedding, &c., of patients labouring under contagious diseases may be effectually (?) disinfected by exposure to a temperature a little higher than that of boiling water for about an hour. Neither the texture nor colour of textile fabrics is injured by a heat of even 250° F. (*Dr Henry*). See Disinfecting Chambers.

It is a practice at some of the workhouses to bake the clothes of the paupers who have the itch, or who are infested with vermin. The soaking and boiling of clothes in the absence of being able to bake them is by no means a bad method

for disinfecting them. The process is rendered the more effective by adding to the water in which they are immersed or boiled 1 part of strong solution of chloride of lime to 20 or 30 parts of water; or carbolic acid in the proportion of 1 part of the pure acid to 100 parts of water. In the German army, if the clothes cannot be baked they are soaked for 24 hours in water containing 1 part of sulphate of zinc to 120 of water, or 1 part of chloride of zinc to 240 of water, after which they are washed in soap and water and dried.

Quicklime rapidly absorbs carbonic acid, sulphuretted hydrogen, and several other noxious gases, and is therefore commonly used as a wash for the walls of buildings. Acetic acid, camphor, fragrant pastiles, cascarilla, brown paper, and other similar substances, are frequently burnt or volatilised by heat, for the purpose of disguising unpleasant odours, but are of little value as disinfectants. The sulphates of iron and zinc have the property of rapidly destroying noxious effluvia. A quantity of either of these sulphates thrown into a cesspool, for instance, will in a few hours render the matter therein quite odourless. Of gaseous disinfectants, "sulphurous acid gas (obtained by burning sulphur) is preferable, on theoretical grounds, to chlorine. No agent checks so effectually the first development of animal and vegetable life. All animal odours and emanations are immediately and most effectually destroyed by it" (*Graham*). See ANTISEPTIC, DEODORISER, FUMIGATION, INFECTION, OZONE, CARBOLIC ACID, SALICYLIC ACID, BACTERIA as originators of disease, LIME, CHLORIDE, CHARCOAL, also the DISINFECTING COMPOUNDS given *below*.

Dr Wynter Blyth divides disinfectants into two great classes: gaseous, and solid or liquid.

I. *Volatile, in the form of Gas or Vapour.*

1. Substances which, like the halogens, appear to form substitution compounds, *e.g.*

Chlorine,
Bromine,
Iodine.

2. Substances which probably combine chemically, and thus destroy contagion:

Sulphurous acid,
Nitrous acid,
Fumes of other acids.

3. Oxidising substances, such as

Pure air,
Oxygen,
Ozone.

4. The volatile oils, &c. Feeble disinfectants, supposed, however, to oxidise:

Camphor,
Oil of hops,
" rue,
" rosemary,
" chamomile.

II. *Solid or Liquid Disinfectants.*

1. The chlorides of different metals, earths, or bases:

Chlorides of the alkalies,
" iron,
" copper,
" manganese,
Chlorides of zinc,
" aluminium,
" lime,
" mercury,

and, in fact, all chlorides which are soluble.

2. All soluble sulphates, especially sulphates of iron and aluminium.

3. All soluble sulphites.

4. Some acetates, as acetate of iron.

5. Some nitrates, such as the nitrates of potash and soda.

6. Certain agents which appear to arrest putrefaction or condense certain gases, &c., without either destruction or oxidation:

Carbolic acid,
Tar acids,
Charcoal,
Great cold,
Heat sufficient to dry organic substances, but not to char them.

7. Preservative liquids and solutions. Many of these act by coagulating the albumen of organised bodies:

Antiseptics,
Alcohol,
Solutions of corrosive sublimate,
" common salt.
" saltpetre.

8. Destructive agents. Not true disinfectants; they act not by disinfection, but by destruction:

A dry heat of 200°—400° F.,
The strong undiluted acids and alkalies.

9. Agents which act in many ways, partly by condensing gases, partly by absorbing moisture, and partly by a peculiar action on organic matter analogous to tannin:

Dry earths,
Clays,
The natural and artificial compounds of aluminium.

The table on the next page is a summary by the late Dr Letheby of some experiments made by Drs Dougall and Calvert, with the view of determining the relative powers possessed by certain substances of arresting putrefaction, as measured by their action in preventing the germination of animalcules and fungi, and the development of vaccine lymph ('On the Relative Power of various Substances in Preventing the Germination of Animalculæ,' by John Dougall, 1871; Calvert, 'Proceedings of the Royal Society,' vol. xx, p. 185).

Disinfecting Compounds. 1. (SIR WM. BURNETT'S DISINFECTING LIQUID.) A concentrated solution of chloride of zinc. See ZINC.

2. (COLLINS' DISINFECTING POWDER.) A mixture of dry chloride of lime, 2 parts, and burnt alum, 1 part. Used either dry or moistened with water. See LIME.

3. (CONDY'S DISINFECTING FLUIDS.) Solutions of the alkaline manganates and permanganates. Although this is an excellent and rapid deodoriser, and makes a most serviceable dressing for fetid sores, it must be borne in mind that it is in no sense an aërial disinfectant, its action being limited to the solid or liquid matters only with which it is brought into immediate contact. It exercises no corrosive action, but it is open to the

Summary of the Experiments made by Dr J. Dougall *and by* Dr Crace Calvert *on the action of various Antiseptics on Protoplasmic and Fungus Life, and on Vaccine Lymph.*

Substances used.		Experiments made by Dr John Dougall, of Glasgow.											Experiments by Dr Crace Calvert.			
		Reaction of the Solution.	Quantity required to prevent Animalcules in six days.				Effect on Animalcules in Putrid Beef Juice and Egg Albumen, when added in proportion in third column.	Number of Days before Life appeared in a solution containing 1 of substance in 500 water and ½ drachm of following—				Effect of the Vapour or Gas during 24 hours on Vaccine Lymph.	Number of Days before Vibrio Life appeared in a solution of Albumen containing 1 of substance in 1000 of solution.			
			Infusion of Hay.	Human Urine.	Beef Juice and Egg Albumen.	Average of all.		Beef Juice.		Sol. of Egg Albumen.						
								Animalcules.	Fungi.	Animalcules.	Fungi.		Animalcules.	Putrid Odour.	Fungi.	Mouldy Odour.
			1 in	1 in	1 in	1 in										
Acids. Mineral	Sulphurous	Acid	250	50	50	117	Death	24	4 P.	8	Over 100	Killed	11	Over 40	21	Over 40
	Nitric	,,	400	400	200	333	,,	18	4 P.	15	5 T.	,,	10	50	10	23
	Hydrochloric	,,	500	400	100	333	,,	28	4 P.	9	Over 100	,,	—	—	—	—
	Sulphuric	,,	800	500	100	467	,,	Over 100	Over 100	30	10 T.	—	9	—	9	11
	Chromic	,,	4000	1400	1200	2200	—	78	38 P.	Over 100	Over 100	—	—	—	—	—
Acids. Organic	Carbolic	Neutral	300	300	200	267	None	12	50 T.	38	36 P.	None	Over 40	Over 40	Over 40	Over 40
	Cresylic	,,	—	—	—	—	,,	—	—	—	—	,,	,,	,,	,,	,,
	Acetic	Acid	350	25	10	125	—	—	—	—	—	Killed	30	—	9	50
	Picric	,,	350	350	350	350	Death	44	11 P.	Over 100	44 P.	—	17	Over 40	19	Over 40
	Benzoic	,,	700	700	200	533	,,	Over 100	Over 100	,,	Over 100	—	—	—	—	—
Alkalies	Lime	Alk.	—	—	—	—	—	—	—	—	—	—	13	19	Over 40	Over 40
	Potash	,,	300	50	10	120	Death	—	—	—	—	—	16	—	—	—
	Soda	,,	—	—	—	—	—	—	—	—	—	—	23	31	18	29
	Ammonia	,,	—	—	—	—	—	—	—	—	—	—	24	50	20	Over 40
Haloids	Iodine tincture	Neutral	400	400	50	283	Death	1	80 T.	15	Over 100	—	—	—	—	—
	Chlorine gas	Acid	—	—	—	—	—	—	—	—	—	Killed	7	21	21	—
	Chloride lime	Alk.	200	200	25	142	Death	27	27 T.	40	Over 100	,,	7	18	16	—
	Chloride zinc	Acid	300	300	300	500	,,	4	Over 100	18	,,	—	Over 40	Over 40	50	Over 40
	Chloride aluminium	,,	2000	500	300	933	—	19	4 P.	Over 100	8 P.	—	10	,,	21	50
Sulphates, &c.	Bisulphite lime	Acid	100	50	25	58	Death	4	92 T.	9	Over 100	—	11	21	14	Over 40
	Sulphate zinc	,,	300	300	200	267	,,	30	4 P.	90	70 P.	—	—	—	—	—
	Sulphate zinc	,,	500	500	100	367	?	14	5 T.	35	40 T.	—	7	Over 40	15	—
	Common alum	,,	800	500	100	467	—	14	3 P.	38	15 T.	—	—	—	—	—
	Sulphate copper	,,	1000	1000	800	933	Death	86	20 P.	Over 100	Over 100	—	—	—	—	—
Permanganate potash		Neutral	500	200	125	275	None	—	—	—	—	—	9	50	22	Over 40
Alcohol		,,	350	50	20	140	Death	4	4 T.	10	Over 100	—	—	—	—	—
Camphor		,,	300	150	50	167	None	—	—	—	—	None	—	—	—	—
Turpentine		,,	—	—	—	—	—	—	—	—	—	—	14	Over 40	42	Over 40

Note.—In the *first* set of Dr John Dougall's experiments 3 drachms of a solution of the strength mentioned were treated with 1 drachm of a filtered infusion of hay, or with half a drachm of urine or half a drachm of the mixture of beef juice and egg albumen. In the *second* set of experiments equal parts of a putrid solution of beef juice and egg albumen, full of living animalcules, and of the solution of the various substances of the strength known to be preventive of life (as in third column), were mixed together, and the results immediately noted. In the *third* set of experiments 3½ drachms of distilled water, containing 1 in 500 of the substances named, were treated with half a drachm of filtered beef juice, or half a drachm of a solution consisting of 1 part white of egg to 4 parts water. In the *last* set of experiments, separate minims of vaccine lymph were exposed to the several vapours for 24 hours, and the dried spot in each case was moistened with glycerin and water, and sealed in a capillary tube until an opportunity for vaccination occurred, when the whole of the diluted lymph was used in one insertion so as to ensure its full effect.

In Dr Crace Calvert's experiments, 0·026 of a gramme of the substance was added to 26 grammes (1 to 1000) of a solution of albumen containing 1 part white of egg to 4 parts *pure* distilled water.

The animalcules observed were Monads (microphymes), Vibrios, and their cell-segments (microerphymes), Bacteria (microzymes), Amœbæ, &c.; and the Fungi were Torula, Mycelium, Penicilium, &c., indicated in Table by letters T and P. Putrefaction was always characterised by a putrid odour, an alkaline reaction, and the presence of animalcules; whereas Mouldiness and Fermentation were distinguished by a mouldy or musty odour, an acid reaction, and the presence of Fungi.

objection that it leaves a brown stain upon linen. See MANGANESE.

4. (ELLERMAN'S DEODORISING FLUID.) This is said to consist chiefly of the perchlorides and chlorides of iron and manganese.

"In a report addressed to the Metropolitan Board of Works in 1859, Drs Hoffmann and Frankland stated that the perchloride of iron was the cheapest and most efficient deodoriser that could be applied to sewage" (*Beasley*).

5. (LABARRAQUE'S DISINFECTING SOLUTION; LIQUOR SODÆ CHLORINATÆ, Ph. L. & D.). A solution of chlorinated soda, or, as it is commonly called, 'chloride of soda.' M. Labarraque made known this valuable disinfectant in 1822, and obtained the prize of the French 'Society for Encouraging National Industry' for its introduction.

6. (LEDOYEN'S DISINFECTING FLUID.) A solution of nitrate of lead, 1 part, in about 8 parts of water; or, of litharge, $13\frac{1}{2}$ oz., in nitric acid (sp. gr. 1·38), 12 oz., previously diluted with water, 6 pints. Sp. gr. 1·40.

7. (SIRET'S DISINFECTING COMPOUNDS.) *a.* A mixture of sulphate of lime, 53 lbs., sulphate of iron, 40 lbs., sulphate of zinc, 7 lbs., and peat charcoal, 2 lbs., made into balls.

b. Sulphate of iron, 20 parts; sulphate of zinc, 10 parts; tan or waste oak-bark (in powder), 4 parts; tar and oil, of each, 1 part; as before. Used for deodorising cesspools, &c.

8. (BISULPHIDE OF CARBON.) This generates, when burnt, sulphurous acid, and is, therefore, a very valuable disinfectant. Its highly inflammable nature, however, renders the adoption of certain precautions necessary in its use. A method of employing it in the form of fumigation will be found under the article FUMIGATION.

9. Dry salicylic acid volatilised from a hot plate purifies the air, and perfectly disinfects the walls of a closed room (*von Heyden*).

10. 'SANITAS' is the name given by Mr Kingzett, its discoverer, to a new liquid antiseptic and disinfectant, containing peroxide of hydrogen and camphoric acid, and obtained by the atmospheric oxidation of turpentine. Sanitas is said by its inventor to possess the great advantages of being non-poisonous, and to exercise no injurious effects either on clothing or furniture. It is stated that its antiseptic power is distributed between the peroxide of hydrogen and camphoric acid, the peroxide of hydrogen being able to evolve large quantities of oxygen, which in this state is nascent, and of a powerful and oxidising character.

11. (COOPER'S UNIVERSAL DISINFECTING POWDER.) According to Professor Wanklyn, this powder contains 70% of mixed chloride of sodium and chloride of calcium, and about 6% of anhydrous sulphate of zinc (equal to about 12% of hydrated sulphate), a little insoluble matter, and 15% of moisture.

12. (DR BOND'S CUPRALUM AND FERRALUM.) The first of these disinfectants is stated to be a mixture of the sulphates of copper and aluminium, with potassic dichromate and turpentine. Its inventor claims for it that it possesses great power of coagulating albumen and high value both as an antiseptic and deodorant. FERRALUM is a mixture of ferrous and aluminic sulphates, turpentine, and carbolic acid. Its chief use is for flushing sewers and in deodorising cesspools, urinals, &c.

13. (BAYARD'S DISINFECTANT.) A mixture of sulphate of iron, clay, lime, and coal tar.

14. (LARMANDE'S ANTIMEPHITIC LIQUOR.) A solution of the sulphates of zinc and copper.

15. (THYMOL.) From experiments made with this substance, it appears to be a very powerful and valuable antiseptic, and likely, because of its non-poisonous and non-irritant qualities, to supplant carbolic acid in various branches of surgical practice, in which this latter agent has hitherto been employed; such, for example, as a dressing for wounds, ulcers, and as a topical application for certain skin eruptions, &c. Its difficult solubility and price (spite of its much greater antiseptic power), however, for the present at any rate, preclude it from being made available as an ordinary common disinfectant, as this term is generally understood. See THYMOL.

16. (SILICATE OF SODA.) It is stated that this salt has considerable anti-putrefactive powers.

17. (ALUMINISED CHARCOAL.) This is recommended by Dr Stenhouse as a cheap and very efficient deodorising agent. It is made by dissolving in water 54 parts of the sulphate of alumina ofcommerce in water, and mixing it with $92\frac{1}{2}$ parts of finely powdered wood charcoal. When the charcoal is saturated it is evaporated to dryness and heated to redness in covered Hessian crucibles till the water and acid are dissipated. The charcoal contains $7\frac{1}{2}$% of anhydrous alumina.

18. (PREPARATIONS FROM COAL-TAR.) Carbolic acid and carbolates. M'Dougall's powder has been noticed under CARBOLIC ACID. Calvert's powder consists of crude alumina with 20% or 30% of carbolic acid. M'Dougall's powder is strongly alkaline from the excess of lime it contains.

Jeye's purifier is a disinfectant containing coal-tar products. It is very cleanly and not offensive. Useful for washing animals and killing vermin, and makes a good lotion for abrasions, foul wounds, &c.

19. (MERCURIC CHLORIDE.) Corrosive sublimate is perhaps the most perfect germicide which we possess, solutions containing but 1 part of the salt in 2000 parts of water being very active. The objections to its general use are, however, great. It is intensely poisonous to all animal life and, despite its great relative activity, very costly.

20. (CARBON CONES AND CASES FOR THE PRODUCTION OF VAPOURS AND GASES FOR MEDICAL AND SANITARY PURPOSES.) "This very ingenious invention is intended to utilise the principles involved in the production of vapours and gases for disinfecting and antiseptic purposes and for the administration of therapeutical agents either as fumigations or as inhalations. A very pure carbon combined with an oxidising agent is moulded into a hollow cone, the walls of which are part for part equal, and the size varying with the use. The central cavity is fitted with a glass flask containing the matter to be dispersed either in vapour or as a gas. The carbon cone and flask are secured on an incombustible base. It will be understood that both the method of applying the necessary heat and the arrangement of the flask and con-

tents are fitted for producing vapours or gases of great dispersive powers. Being placed in a room to be disinfected or deodorised, the cone is lighted at the apex, and burns slowly and steadily downward. As the carbon encasement is adjusted in substance to the amount of heat desired to be obtained, the result of this steady progression of heating is that the *neck* of the flask is the first to become intensely elevated in temperature, the heat slowly reaching the inner contained principle. The layer of the contained substance first affected by the heated glass is at once raised into a state of vapour, which is propelled with great force along the superheated tubulure of the flask, and eventually escapes into the air in the form of a high visible column. As there is no tension on the mouth of the flask, there can be no destruction of the contained substance, for whatever is capable of being vapourised at any given temperature by this method must at that temperature escape. The contents of the flask *never boil.* Since it is possible by means of these cones to reach 537·7° C. (1000 F.), the method becomes practicable for obtaining a large number of vapours and gases, such as oxygen, chlorine, bromine, iodine, sulphurous acid, nitrous oxide, carbolic acid, creosote, tar, terebene, camphor, eucalyptus, calomel, mercuric chloride, ammonio-chloride of mercury, and the various essential oils. The system is a ready means of employing certain bodies for disinfecting and antiseptic purposes, not only more efficiently, but with decided economy. The new method has many advantages over the methods in use at present, such as sprays, hot plates, fuming papers, &c. Such contrivances are not only troublesome as a rule, but do not deliver a sufficiently constant, dry, attenuated, and active vapour or gas. This is exactly what these cones yield. With these, too, a volume of vapour or gas may be produced of any magnitude from a few cubic inches to many thousand cubic feet. An arrangement has also been provided by which the cones can be adjusted to an inhaler with or without water vapour" ('Practitioner').

The following are advertised:

Terebene.	Carbolic et Lavender.
Terebene et Iodum.	Hydrarg. Subchlor.
Thymol.	Oxygen Gas.
Eucalyptus.	Carbolic.
Pinus Sylvestris.	Sulphurous Acid.
Ammon. Chloride.	Chlorine.
Bromo Eucalyptol.	Bromine.
Creosote.	Iodine.
Carbonic & Acetic Acid.	Mercuric Chloride.
Thymol et Lavender.	Perfumes.

The natural disinfectants are air and water.

Air, when in violent motion, as is the case during a hurricane, has in many instances been known to arrest the course of certain epidemics; whilst in the form of ordinary ventilation, although inadequate alone to destroy the causes (whatever they may be) of contagion or infections, it is nevertheless found to supplement, to a considerable extent, the application of artificial and specific disinfectants. Hence the paramount necessity of perfect ventilation in all apartments, in which the sick are placed, and hence also the measures taken in all hospitals to ensure by this means an increasing supply of fresh air to the wards in which the patients are lying.

The diminution in the amount of sickness prevailing in an army caused by the removal of the soldiers from barracks and placing them in sheds or under canvas is another illustration, tending to show the disinfectant properties possessed by an atmosphere in a state of circulation, when, of course, other hygienic precautions are not neglected.

In Hammond's 'Hygiène' for 1863 the author, who was surgeon-general in the United States army, says that he only met with one instance of hospital gangrene in a wooden pavilion hospital, and not a single one in a tent; and the same result is recorded by Kraus, of the Austrian army, in 1859, who says he never discovered that gangrene originated in a tent; that, on the contrary, cases of gangrene at once began to improve when those suffering from the disease were sent from hospital wards into tents. In his work on 'Practical Hygiène' Dr Parkes advises all cases of typhus occurring in barracks, whenever practicable, to be sent to tents or wooden huts having badly-jointed walls.

The great solvent power of water, superadded to its being able to hold matters in suspension, renders it a most important disinfectant, and thus enables it in the form of rain to remove from the atmosphere many noxious and pestilential bodies that would doubtless, if allowed to increase, become a source of disease. The air-current which constitutes the ventilation of the House of Commons, before entering the Commons' chamber, is made to pass over a fine spray of water, by which means it has any dust or other organisms washed out of it. The beneficial effect of rain also in flushing drains and canals, and sweetening the superincumbent air, and of washing out of it many solid as well as gaseous objectionable impurities, is well known. The year 1860 was one of the wettest on record, as it was also one of the healthiest. Dr W. Budd recommends that when a room is to be disinfected, a short time before the process is commenced a tub of boiling water should be placed in the apartment, so that the steam may become condensed on the walls, and diffused throughout the air, as he believes there is a greater chance of ensuring the destruction of the disease germs by the aërial disinfectants than if these latter were allowed to act on the germs in the dry state.

We have already enforced in these pages the importance of the habit of personal cleanliness as being one of the greatest aids to the preservation of health; and although the unstinted use of soap and water will alone fail to effect the removal of any infectious or contagious maladies, their use will be found important auxiliaries in assisting recovery. But personal ablution is not the *sine quâ non.* The frequent cleansing of our dwellings, streets, alleys (more particularly culs-de-sac), lanes, and the sheds and habitations of animals, by soap and water, or water alone, as well as the removal of all decaying or refuse materials from our midst, is of equal importance, and must not be disregarded, if we desire to make our sanitary surroundings such as they ought to be.

In streets where there is much traffic the air above has been found to contain large quantities of dust composed, amongst other matters, of the remains of horse-droppings; hence the great importance of assiduously watering and cleansing the thoroughfares of all large cities and towns. A plan for laying the dust of streets has been suggested by Mr Cooper, and consists in watering them with waste chlorides of calcium and magnesium. Carbolic acid has been employed for the same purpose by many urban authorities for some years past.

We extract the following from Dr Parkes' valuable work, 'Practical Hygiène:'

"*Disinfection of Various Diseases.*

"EXANTHEMATA, SCARLET FEVER, AND ROTHELN. The points to attack are the skin and throat. The skin should be rubbed from the very commencement of the rash until complete desquamation, with camphorated oil, or oil with a little weak carbolic acid. The throat should be washed with Condy's fluid, or weak solution of sulphurous acid.

"Clothes to be baked, or to be placed at once in boiling water, as directed further back. The clothes should not be washed at a common laundry. Chlorine or euchlorine should be diffused in the air, the saucer being put some little distance above the head of the patient. Carbolic acid and ether or carbolic acid spray may be used instead.

"*Smallpox.* In this, as in all cases, there can be no use in employing aërial disinfectants, unless they are constantly in the air, so as to act on any particle of poison which may pass into the atmosphere.

"The skin and the discharges from the mouth, nose, and eyes are to be attacked. There is much greater difficulty with the skin, as inunction cannot be so well performed. By smearing with oil and a little carbolic acid and glycerin, or, in difficult cases, applying carbolised glycerin to the papules and commencing pustules, might be tried. The permanganate and sulphurous acid solutions should be used for the mouth, nose, and eyes. The clothing should always be baked before washing, if it can be done.

"The particles which pass into the air are enclosed in small dry pieces of pus and epithelial scales; and Bakewell, who has lately examined them, expresses great doubts whether any air purifier would touch them. Still it must be proper to use euchlorine or carbolic acid. Iodine has been recommended by Richardson and Hoffmann.

"*Measles.* Oily applications to the skin and air purifiers, and chlorides of zinc and aluminium in the vessels receiving the expectoration, appear to be the proper measures.

"*Typhus* (*Exanthematicus*). Two measures seem sufficient to prevent the spread of typhus, viz. most complete ventilation and immediate disinfection and cleansing of clothes. But there is also more evidence of use from air purifiers than n the exanthemata. The nitrous acid fumes were tried very largely towards the close of last century and the beginning of this in the hulks and prisons where Spanish, French, and Russian prisoners of war were confined. At that time so rapidly did the disease spread in the confined spaces where so many men were kept, that the efficacy even of ventilation was doubted, though there can be no question that the amount of ventilation which was necessary was very much underrated. Both at Windsor and Sheerness the circumstances were most difficult. At the latter place (in 1785), in the hulk, 200 men, 150 of whom had typhus, were closely crowded together; 10 attendants, and 24 men of the crew were attacked; 3 medical officers had died when the experiments commenced. After the fumigations one attendant only was attacked, and it appeared as if the disease in those already suffering became milder. In 1797 it was again tried with success, and many reports were made on the subject by army and naval surgeons. It was subsequently largely employed on the Continent, and everywhere seems to have been useful.

"These facts lead to the inference that the evolutions of nitrous acid should be practised in typhus-fever wards, proper precautions being taken to diffuse it equally through the room, and in a highly dilute form.

"Hydrochloric acid was employed for the same purpose by Guyton de Morveau in 1773, but it is doubtless much inferior to nitrous acid. Chlorine has also been employed, and apparently with good results.

"In typhus it would seem probable that the contagia pass off entirely by the skin; at least, the effect of ventilation and the way in which the agent coheres to the body-linen seems to show this.

"The agent is not also enclosed in quantities of dry discharges and epidemics, as in the exanthemata, and is therefore less persistent and more easily destroyed than in those cases. Hence possibly the greater benefit of fumigations, and the reason of the arrest by ventilation. The clothes should be baked, steeped, and washed, as in the exanthemata.

"*Bubo Plague.* The measures would probably be the same as for typhus.

"*Enteric* (*typhoid*) *Fever.* The bowel discharges are believed to be the chief, if not the sole agents in spreading the disease; the effluvia from them escape into the air, and will adhere to walls and retain power for some time, or the discharges themselves may get into drinking-water. Every discharge should be at once mixed with a powerful chemical agent; of these, chloride and sulphate of zinc have been chiefly used, but sulphate of copper (which Dougall found so useful in stopping the growth of animalculæ), chloride of aluminium, or strong solution of ferrous sulphate (1 oz. to a pint of water), or carbolic acid. After complete mixing the stools must be thrown into sewers in towns; but this should never be done without previous complete disinfection. In country places they should be deeply buried at a place far removed from any water supply; they should never be thrown on to manure heaps or on to middens, nor into earth-closets, if it can be possibly avoided. As the bedclothes and beds are so constantly soiled with the discharges, they should be baked, or if this cannot be done, boiled immediately after removal with sulphate or chloride of zinc. It would be less necessary to employ air purifiers in this case than in others.

"*Cholera.* There can be little doubt that the discharges are here also the active media of the conveyance of the disease, and their complete disinfection is a matter of the highest importance. It is, however, so difficult to do this with the immense discharges of cholera, especially when there are many patients, that the evidence of the use of the plan in the last European epidemic is very disappointing.

"The ferrous sulphate (green vitriol), which has been strongly recommended by Pettenkofer as an addition to the cholera evacuations, was fully tried in 1866 at Frankfurt, Halle, Leipzig, in Germany, and at Pill, near Bristol, and in those cases without any good result. In other places, as at Baden, the benefit was doubtful. It seemed to answer better with Dr Budd and Mr Davies at Bristol; but other substances were also used, viz. chlorine gas in the rooms, and chloride of lime and Condy's fluid for the linen. On the whole it seems to have been a failure. Ferric sulphate, with or without potassium permanganate, has been recommended by Kühne instead of ferrous sulphate, but I am not aware of any evidence on the point. Carbolic acid was largely used in England in 1866, and appeared in some cases to be of use, as at Pill, near Bristol, and, perhaps, at Southampton. It failed at Erfurt, but, as it is believed the wells were contaminated by soakage, this is, perhaps, no certain case. Chloride of lime and lime were used at Stettin without any good result, and, on the whole, it may be said that the so-called disinfection of the discharges of cholera does not seem to have been attended with very marked results. At the same time it cannot be for a moment contended that the plan has had a fair trial, and we can easily believe that, unless there is a full understanding on the part of both medical men and the public of what is to be accomplished by this system, and a conscientious carrying out of the plan to its minutest details, no safe opinions of its efficacy or otherwise can be arrived at. It would be desirable to try the effect of chromic acid or bichromate of potash.

"With regard to air-purifiers little evidence exists. Chlorine gas diffused in the air was tried very largely in Austria and Hungary in 1832, but without any good results. Nitrous acid gas was used in Malta in 1865, but apparently did not have any decided influences, although Ramon da Luna has asserted that it has a decided preservative effect, and that no one was attacked in Madrid who used fumigations of nitrous acid. But negative evidence of this kind is always doubtful. Charcoal in bulk appears to have no effect. Dr Sutherland saw a ship's crew severely attacked, although the ship was loaded with charcoal.

"Carbolic acid vapour diffused in the atmosphere was largely used in 1866 in England; the liquid was sprinkled about with water, and sawdust moistened with it was laid on the floors and under the patients. The effect in preventing the spread of the disease was very uncertain.

"*Yellow Fever.* In this case the discharges, especially from the stomach, probably spread the disease, and disinfectants must be mixed with them.

"Fumigations of nitrous acid were employed by Ramon da Luna, and it is asserted that no agent was so effectual in arresting the spread of the disease.

"*Dysentery.* It is well known that dysentery, and especially the putrid dysentery, may spread through an hospital from the practice of the same close stool or latrines being used. As long ago as 1807 fumigations of chlorine were used by Mojon to destroy the emanations from the stools, and with the best effects. The chlorine was diffused in the air, and the stools were not disinfected; but this ought to be done as in enteric fever, and especially in the sloughing form. It is probable that carbolic acid in large quantity would be efficacious.

"With respect to *Erysipelas*, *Diphtheria*, *Syphilis*, *Gonorrhœa*, *Glanders*, and *Farcy*, local applications are evidently required, and carbolic acid in various degrees of strength, and the metallic salts are evidently the best measures.

"*Cattle Plague.* The experiments made by Mr Crookes on the disinfectant treatment of cattle plague with carbolic acid vapour have an important bearing on human disease. Although the observations fall short of demonstration, there are grounds for thinking that when the air was kept constantly filled with carbolic acid vapour the disease did not spread.

"So also euchlorine was employed in Lancashire by Professor Stone, of Manchester, with apparent benefit. Dr Moffat employed ozone (developed by exposing phosphorus to the air), and he believes with benefit. As such experiments are very much more easily carried out on the diseases of animals than on those of men, it is much to be wished that the precise effect of the so-called disinfectants should be tested by continuing the experiments commenced by Mr Crookes, not only in cattle plague in the countries where it prevails, but in epizootic diseases generally.

"It may be said, in conclusion, that although positive evidence is so deficient, yet, taking into consideration the decidedly great and known effect of many so-called disinfectants and air-purifiers on organic matters, and the fact that the infectious organic agencies are certainly easily destroyed in most cases (since free ventilation renders many of them inert, and few of them retain their power very long), it is highly probable that the specific poisons of the so-called zymotic diseases are destroyed by some of these chemical methods; and at any rate, the careful and constant use of chemical agents for the destruction of the specific poisons in the excreta and discharges from the body, and when they pass into the air, is not only warranted but should be considered comparative.

"*Purification of Rooms after Infectious Diseases.* In addition to thorough cleansing of all woodwork with soft soap and water, to which a little carbolic acid has been added (1 pint of the common liquid to 3 or 4 galls. of water), and to removal and washing of all fabrics which can be removed, the brushing of the walls, the room should be fumigated for 3 hours with either the fumes of sulphurous or nitrous acids. Both of these are believed to be superior to chlorine, especially in smallpox. All doors and windows

and the chimney being closed and curtains taken down, the sulphur is ignited as directed in our article FUMIGATION.

"In white-washed rooms the walls should be scraped and then washed with hot lime, to which carbolic acid is added.

"Mortuaries and dead-houses are best purified with nitrous acid."

These directions may be supplemented by the following:—The towels, sheets, articles of clothing, &c., should be boiled in water or plunged in boiling water containing 1 to 2 handfuls of soda to the gallon, before being taken from the room, after which treatment they should be steeped in water containing 4 fl. oz of carbolic acid to a gallon of water.

Fabrics soiled by the discharges, &c., such as rags, bandages, and dressings, if of little value, should be immediately consigned to the flames; but if this be not convenient, they may be treated with carbolic acid and water in the same manner as directed for towels, sheets, &c.

As soon as any infectious disease sets in, the room of the patient should be at once stripped of curtains, carpets, bed-curtains, valances, and all unnecessary garments, whether in a wardrobe or drawers, as well as of all superfluous furniture, especially chairs stuffed with wool or covered with fabric of any kind.

Disinfection of the apartment by fumigations must be postponed until it is vacated; as before such a time thorough disinfection is impossible.

Infected bedding, &c., should be removed in the boxes made for the purpose, and subjected to the heating process. In most towns provision is made by the Board of Guardians, and under the directions of the medical officer of health, for the disinfection process to be efficiently carried out. See DISINFECTING CHAMBERS.

The disinfection of articles of food is accomplished by thorough cooking, boiling in the case of milk, boiling and filtration in the case of water, and complete roasting, stewing, and frying of meat.

We have described under "CHARCOAL" the disinfecting properties of that substance. These properties have been turned to excellent account by Dr Stenhouse, who has invented a charcoal respirator, which, causing the wearer to breathe air drawn through a layer of that substance, and by thus depriving the air so inspired of any noxious gases or exhalations, if present, becomes, if worn in an infected atmosphere, a great safeguard against disease. Dr Letheby was accustomed to use a charcoal respirator when analysing dead bodies and other putrid matters of suspected poisoning, and by so doing never experienced any ill effects, nor was he conscious of the offensive odour which but for its adoption he must have encountered.

Professor Tyndall has suggested for the same purpose a respirator of cotton wool, by means of which the air, being filtered before it enters the lungs, becomes deprived of minute particles of various substances suspended in it, as well as of the germs, which so many pathologists believe to be always present during the prevalence of epidemic maladies, and the cause, when inhaled, of the maladies themselves.

Despite all that has been done in recent years to advance our knowledge of the causes of disease and the means of preventing its spread, it must be confessed that our methods of disinfection are to a very large extent empirical; the use of fire, dry heat, and steam, and powerful chemical agents are rather methods of destruction than scientific disinfection, and common experience shows that, where the means exist, abundance of fresh pure air is, perhaps, as powerful a disinfectant as any of those more or less violent agents; that is to say, the necessity for special means of disinfection on a large scale is one of the results of the crowding together of population in cities and towns. We trust our health to an elaborate system of drainage which, so long as it is efficient, removes from our midst what might otherwise be a source of disease; but if the system becomes defective at any point, we are soon made aware that, in attempting a high degree of cleanliness, we have put a whole city in such a state of perfect communication that the spread of infection is materially assisted, and hence the urgent necessity, which exists in all towns with a system of sewers, of keeping the drains clean and preventing stagnation and putrefaction of the materials caused by them. Perfect ventilation and constant and efficient flushing will do much, but we are obliged continually to use special means in the shape of disinfectants, so called, to stop these processes, and where the materials are abundant this is not difficult; in many places this wholesale disinfection is a serious expense.

None of the disinfectants which act by diffusion through the air and kill (?) organisms floating in it are satisfactory. A heavy shower of rain is probably worth many tons of such disinfectants, and the oxidising power of a stiff north-easter infinitely superior to any artificial means which could be devised. The conditions under which we live are, however, such, that the operations of nature are greatly interfered with, and we must do our best to make good the loss by scrupulous cleanliness and the removal and destruction of all filth and garbage from our homes; and there is a large basis of truth in the answer of a student to the question, "What is a disinfectant?" "something which makes such a stink that it forces people to open their windows."

DISINFECTING CHAMBERS. The sanitary authorities of most large cities have made provision for the purification of mattresses, linen, wearing apparel, &c., by means of disinfecting chambers or ovens, in which receptacles the infected articles are subjected for a certain time to hot air. The simplest form of apparatus for this purpose, and one that could be used on an emergency, provided the articles to be disinfected were not too bulky, is a baker's oven. The drying closet of a good laundry would be so far unsafe, because it would occasionally fail to give a heat sufficient for the destruction of the noxious principles.

The disinfecting chambers employed in Liverpool are arched ovens of solid brick-work, having a depth of 7 feet from front to back, a width of 5 feet from side to side, and a height of 6½ feet from the floor to the crown of the arch. The

doors are made of wrought iron, tightly fitting into cast-iron framework. The floors are made of double iron gratings, having alternate openings, so arranged as to admit at pleasure hot air into the chamber. At the top of the arch there is an opening fitted with an iron valve, by which the air of the chamber escapes into an exhausting shaft which is connected with the chimney. The heating is accomplished by means of a cast-iron cockle, the smoke from which escapes by two cast-iron smoke flues, which, after forming a coil for the purpose of affording as great a heating surface as possible, pass along the hot-air passage under the chamber into a chimney situated at the opposite end.

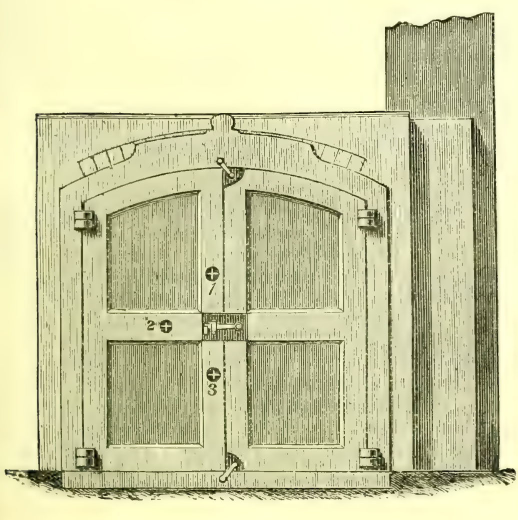
The cold air is drawn into a brick flue placed underneath the floor of the stokehole into a cavity on each side of the cockle, and thence into a space underneath the chamber, whence it becomes heated by the radiation from the surface of the two cast-iron flues. From this cavity or passage it is conveyed at will through the gratings as already described. At the entrance of the cold air flue there is a damper, by which the temperature of the air may be regulated. A heat equal to 280° F. has been registered in this chamber, and as high as 380° F. in a drying closet over the cockle. Dr French, the medical officer of health for Liverpool, says that, if necessary, a temperature reaching 500° F. can be attained in these chambers; but this temperature is of course never employed. Experience has proved that from 220° to 250° F. is the most suitable. Instances have been known where fabrics, after being exposed for some length of time to a temperature above 212° F., have sustained injury from being scorched.

In some of the chambers carbolic acid powder is sprinkled on the floor.

We have taken the liberty of transcribing the following description and plates illustrative of the disinfecting stove used in the Royal Victoria Yard, Deptford, from that very useful publication, 'Chemistry, Theoretical, Practical, and Analytical,' published by Mr W. Mackenzie.

"This stove consists of a brick chamber with a slightly arched roof, and an iron movable floor in two pieces. The chamber is 7 feet deep, 6 feet 9 inches wide, and 5 feet 8½ inches high in the centre of the arch. It is heated by a flue below the iron floor passing round 3 sides of the chamber and up a chimney. There is an opening in the upper part of the chamber in its centre, which passes along in the roof to the side, from thence down in the wall entering beneath the fire; this carries away any of the foul air of the clothes from the chamber through the fire and up the flue. This proceeding takes place after the clothes have been in the chamber say an hour and a half in the following manner:—The damper in the foul air shaft is withdrawn, and the furnace door is shut; any draught that gets to the fire comes to the chamber. Over the opening into the furnace is a square opening, fitted with a glass, inside of which is a fixed thermometer. When this shows a temperature of 200° F., the interior of the chamber is at 250° F., the highest point at which it is allowed to be. In the interior of the chamber at the sides there are little movable cranes, three rows of three supporting rods of iron on which wooden trays rest, and on which the clothes are placed when the iron cart is not used. The cranes move fore and aft to be out of the way when the cart is used. The cart is of iron on wheels, and runs into the chamber on tramways to keep it in position; in the interior of the cart are three iron trays for laying the clothes on. The lowest tray is always the hottest, so that it is prudent to use the cart, the iron bottom of which prevents burning. The iron ends of the cart are removed when it is placed in the chamber; so is the handle. It is usual to keep the clothes at the temperature of 250° F. for two hours.

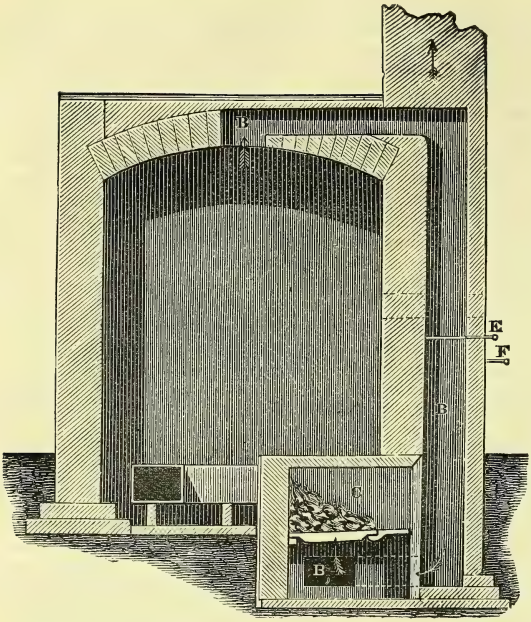
"There is a trap-door 8 inches square about 14 inches above the upper edge of the furnace, and on a level with the iron floor of the chamber, for disinfectants. Carbolic acid and sulphur are used; the former is placed on a flat plate, the latter is sprinkled over the floor. These are used as the last, and after that has been done the clothes are fit to be used without danger to any one."



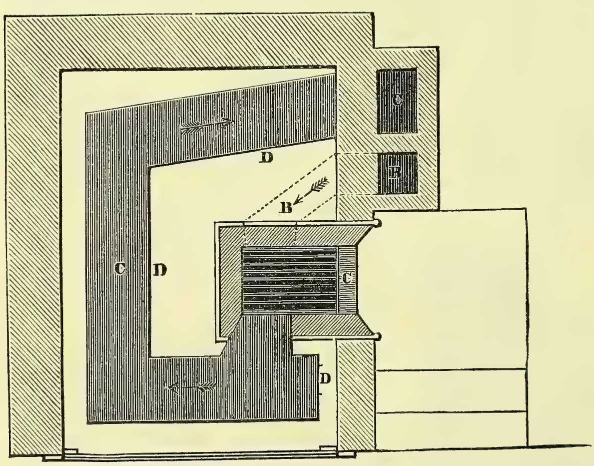
Elevation plan shows the front of the chamber with the doors closed; the openings (Nos. 1, 2, and 3) are for inserting the long thermometer, which is pushed into the clothing to be disinfected; they correspond with the three trays. The thermometer can be withdrawn and examined without allowing much cold air to enter; plugs fit into these three openings when not used for the thermometer.

Section.—The chamber is shown about the centre of its depth; the foul-air shaft (B) passes along the roof down the side wall, and beneath the fire (C); the opening where the fixed thermometer is placed is marked with dotted lines. The damper for the foul-air shaft (E) is represented as shut, and the damper for the chimney (F) is also shut.

The ground plan shows the flue beneath the iron plates, which form the floor



of the chamber, the dotted lines showing the foul-air flue (B), as it passes beneath the fire. In the flue (C) there are openings at D, D, D, for the purpose of cleaning it.



Another form of disinfecting chamber is that invented by Dr Esse, of Berlin, and employed in that city. The apparatus consists of two iron cylinders, one fitted within the other, with a space between, into which steam under pressure is introduced. The outer cylinder is surrounded with wood and the top with felt to prevent the escape of heat. The articles to be disinfected are put in at the top of the inner cylinder, the inside of which soon becomes heated up by the surrounding steam. A pulley is used to lift the lid of the inner cylinder, around which the clothes are hung on pegs, not being allowed to touch the side of the cylinder. At the top of the inside cylinder is a brass box pierced with holes at the bottom, which dips a little way down, through which the air from the interior can rise. In this box, the bulb of a thermometer being placed, the temperature of the inner chamber can be registered.

When the steam condenses in the space between the cylinders it is carried off by means of a valve, which is lifted when the water reaches a certain point in the condenser. In an hour's time the temperature of the interior cylinder can be raised to 235° F.

For heating mattresses another apparatus has been devised by Dr Esse. It consists of an iron case with a spiral steam pipe in the centre, the steam inside the pipe being compressed to two atmospheres.

Dr Ransome has invented, for the use of the Nottingham hospital, a gas stove in the form of an iron box, well packed with a non-conducting material, which surrounds the outside. A channel leads to the interior of the box, and inside this channel gas is kept burning in such a manner by a modification of Kemp's regulator, that the temperature of the box shall range day and night between 235° and 255° F.

An apparatus put to great use by the Holborn District Board during the epidemic of smallpox in 1871 was one made by Fraser's patent. Mr Fraser's disinfecting chamber consists of an oven or receptacle made of brick, with doors in front. Situated on the lower portion of this chamber is a covered furnace connected with flues, by means of which the interior space is heated to the desired temperature. By a particular arrangement the air laden with the noxious vapours given off by the tainted clothing is conveyed into the furnace, and so consumed. Belonging to the apparatus is a covered truck or cart, fitted with doors and dampers, and provided inside with racks and shelves for holding the materials to be purified, which are thus brought from the infected dwelling and placed, truck and all, inside the chamber. The infected materials, as well as the truck containing them, are then heated to the necessary point, disinfection being assisted by sulphurous acid gas, or some other material adapted for the purpose. When the process is finished the carriage with its contents is drawn back to the house from which they were originally taken, and the purified articles are restored to the owners. It will be seen that by this arrangement the vehicle is disinfected as well as the clothes it contains.

A very full and complete description of apparatus for disinfection by heat will be found in a report on disinfection by heat, by H. F. Parsons, M.D., in the 'Report of the Med. Off. Local Govt. Board for 1884.' See REFUSE, DESTRUCTION OF.

DISLOCA'TION. *Syn.* LUXATION; DISLOCATIO, L. The forcible displacement of a bone from its socket, either by violence or disease. "The existence of a dislocation will be evidenced by the deformity produced in the joints, the ordinary shape of which will be materially altered, whilst the extremity of the displaced bone will form an unusual projection in the neighbourhood of the articulation. The limb will have assumed an unusual position, in which it will be fixed unless the dislocation should happen to be complicated with a fracture of the shaft of the bone, in which case there will be an abnormal amount of motion in the lower part of the limb, while the upper part will remain fixed and distorted" (*Heath*).

Gentle manipulation and extension will often reduce a recent dislocation. The improper application of force may greatly aggravate the damage. The limb should be well supported by a sling or splints and skilled assistance obtained.

DISPLACE'MENT. See PERCOLATION.

DISTEMPER is a febrile disorder specifically affecting the mucous membrane of the eyes and nose. The general symptoms are those of febrile catarrh. "The dog shivers, is dull, restless, with dry nose and injected eye. The appetite is partially lost; there is thirst and rapid loss of flesh and condition; the urine is high-coloured and scanty; the bowels are generally irregular, sometimes constipated, sometimes looser than natural; the fæces are dark-coloured and fœtid. In the course of a few days the catarrhal symptoms, which at first may have been limited to frequent sneezing, with a slight discharge from the nose and eyelids, are fully confirmed. The nasal discharge is now more or less profuse; the eyes are weak, occasionally inflamed, and discharge tears and mucus. Very often the eyelids will be gummed together, and the animal thus rendered temporarily blind. Cough is present, at first dry and husky, afterwards moist. The breathing is sometimes much quickened, and the cough dry and painful, showing that the lung-tissue and pleura are affected; the pulse may range from 120 to 150 beats per minute, and the temperature is increased. As the disease advances, debility rapidly increases, the dog being often at the end of the first week scarcely able to stand; the appetite becomes more and more impaired and the digestive powers much debilitated. Food now partaken of or forced upon the animal is quickly ejected by vomiting, or passes through the intestinal canal in a fœtid, ill-digested condition. At the end of about a fortnight these symptoms may abate in intensity, and the dog slowly regain its strength" (*Williams*).

Complications are common and tend to a fatal termination.

1. *Pneumonia.* The respiration is laboured and rapid, the feebleness very great; the dog is very often unconscious.

2. *Jaundice* due to catarrh of the bile-duct, which becomes thereby blocked.

3. *Vomiting and Purging.* The dejecta are sometimes bloody, and there is considerable abdominal pain.

4. *Convulsions,* with coma and paralysis. These are epileptic in character.

Distemper appears to be transmissible from dog to dog, and sometimes rages as an epizootic.

Treatm. In the early stages castor oil in doses from 1 teaspoonful to 1 oz., according to the size of the dog, is useful, and serves to remove any undigested or irritating material from the intestines. Williams recommends sodium hyposulphite in doses of from 2 to 6 gr. as useful in modifying and reducing the severity of the symptoms. Warmth, fresh air, cleanliness, plenty of water or milk and water to drink, with such simple nourishing food as the dog will take. After the first week occasional small doses of quinine are useful, but should be discontinued if they disagree with the dog. All sources of irritation should be attended to, *e.g.* teething by lancing the gums, worms by the administration of areca nut; and if the animal's appetite be lost, beef tea, eggs beaten in milk, and, if the strength is failing much, beef tea with a little brandy. Excess of stimulants is to be avoided (*Williams.*) The complications are difficult to treat, especially the nervous phenomena, and very little can be done by the use of drugs. Chloral hydrate is useful if the dog be unable to sleep.

Healthy dogs should be kept away from the patient, and all foul bedding, &c., carefully destroyed. Kennels should be very thoroughly cleansed and disinfected.

DISTILLA'TION. The evaporation and subsequent condensation of the vapour of liquids, by means of a still and refrigerator, or other similar apparatus. DRY DISTILLATION is a term applied to the distillation of substances *per se,* or without the addition of water or other volatile liquid. DESTRUCTIVE DISTILLATION is the distillation of substances at temperatures sufficiently high to decompose them, by which their elements are separated, or evolved in new combinations. FRACTIONAL DISTILLATION is the separation of substances having different boiling-points, by distilling the mixture at a gradually increasing temperature, and collecting the products which come over at different temperatures in separate receivers. See HYDROCARBON, STILL, &c.

Distillation. The art of the distiller; the manufacture of spirituous liquors as practised on the large scale.

The process of distillation, as carried on in the distilleries of Great Britain, may be divided into four general operations, viz.—1. The mashing, or formation of a saccharine solution from certain vegetable matters, as malt, barley, oats, rye, &c. 2. The cooling of this wort or liquor. 3. The fermentation, or process by which the sugar of the cooled wort is converted into alcohol. 4. The separation of the spirit so formed by means of a still and refrigerator. By the first operation the materials for the formation of the alcohol are obtained; by the second, they are brought to a temperature most favourable to the transformation that takes place in the third, after which it only remains to free the product of the last operation from the foreign matter with which it is associated; this is done in the fourth, which,

correctly speaking, constitutes the only part of the process which can be called distillation.

The general principles of the first three of the preceding operations are noticed in the articles BREWING, FERMENTATION, &c. It will there be seen that the amylaceous or starchy matter of the grain is first 'saccharified,' and afterwards converted into alcohol, and that certain precautions are necessary to render the process successful and economical. In many of the distilleries of Great Britain molasses and analogous saccharine substances are employed, and in this case the sugar essential to the formation of alcohol is already present, and merely requires solution in water at a proper temperature to be ready to be subjected to immediate fermentation.

In general, however, the sources of spirit in England are the various kinds of grain; barley, rye, maize, and rice are those commonly employed, These are ground and mixed with bruised malt, in various proportions, and are mashed in a similar manner to malted grain; sometimes beetroot, potatoes, &c., are used. The fermentation is carried on until the density of the liquor ceases to lessen or 'attenuate,' which is determined by an instrument called a saccharometer, and requires about 4 days. When this point is arrived at, the 'wash' is submitted to distillation, to prevent the access of the acetic fermentation, which would lessen its alcoholic value.

The process of distillation is now so conducted that, by a kind of dissociation of the mixture of the vapours of alcohol and water, alcohol of any desired strength can be prepared. The apparatus consists essentially of three parts:

1. The still or vessel in which the fermented mash is placed.
2. Two condensing apparatus, one of which serves as rectifier, while the other completes the condensation of the products.
3. A dephlegmator in which the mixed vapour separates, a portion of the water becoming condensed and a vapour richer in the alcohol being carried on; this latter is carried into the cooling apparatus, while the former flows back into the still.

Pistorius first introduced in Germany an apparatus of this description; it is fitted with two stills ingeniously connected with rectificators and dephlegmators; it not only extracts the alcohol from the mash, but produces it in a pure and concentrated state, and that with the least possible expenditure of fuel and labour. For further particulars, see Wagner's 'Chemical Technology.' Other forms of distilling apparatus in use are those of Schwartz, Siemens, and Ilges.

In France, Spain, and Portugal the distillation of spirits from wine is carried on. The quality of the spirit depends upon the degree of ripeness of the grapes, and the care bestowed upon the fermentation and distillation; a residue remains in the retort called *vinasse;* it contains a large quantity of glycerin, which may thus be obtained as a by-product.

We have said that the processes of mashing, &c., in the distillery are similar to those adopted in brewing beer. We may add that, as richness in alcohol, and not flavour, is the object aimed at in the distiller's wash, not only is a large quantity of unmalted grain employed, but the process of boiling the wort with hops is omitted altogether. The wort is commonly 'set' at 70° F., and the fermentation and attenuation of the liquor pushed as far as possible by large and repeated doses of the best 'top-yeast' of the porter brewers.

It often happens that raw spirit prepared from damaged grain is contaminated with a highly acrid and volatile fatty substance, which is powerfully intoxicating and irritating to the eyes and nostrils, and possesses an odour very similar to that of an alcoholic solution of cyanogen. This may be got rid of by dilution with water and skilful rectification, when most of it passes over with the first and last 'runnings,' the intermediate portion being less loaded with it. Another plan is to filter the spirit successively through 6 or 7 separate vessels containing pine or willow charcoal before rectifying it. In some distilleries the contaminated spirit is well agitated with a considerable quantity of olive oil, and after repose decanted, diluted with water, and rectified as before. The ordinary corn oil or fusel oil of raw spirit is generally, for the most part, intercepted by a self-regulating bath arranged between the still-head and the refrigerator.

The quantity of spirit obtained from various substances, and even from pure sugar, depends upon the skill with which the several operations are conducted. By theory pure sugar should yield 51% of alcohol; but in practice 11·925 galls. of proof spirit is the largest quantity which has yet been obtained from 112 lbs. of sugar. By the Revenue authorities this weight of sugar is estimated to afford 11½ galls. of proof spirit. The average product is, perhaps, about 1 gall. of spirit of this strength for every 10 lbs. of sugar. According to Harmstädt, 100 lbs. of starch yield 35 lbs. of alcohol, or 7·8 galls. of proof spirit; and 100 lbs. of the following grains produce the accompanying quantities by weight of spirit of sp. gr. ·9427, or containing 45% of pure alcohol:—Wheat, 40% to 50%; rye, 36% to 42%; barley, 40%; oats, 36%; buckwheat, 40%; maize, 40%; the mean being 3·47 galls of proof spirit. It is found that a bushel of good malt yields 2 galls. of proof spirit, and that the largest quantity of proof spirit obtained from raw grain, mashed with 1-5th or 1-6th of malt, does not exceed 22 galls. per quarter.

The distiller is allowed to produce wort from any substance, and at any specific gravity, provided such gravity can be correctly ascertained by the saccharometer approved of by the Board of Inland Revenue. He is not, however, allowed to mash and distil at the same time. See ALCOHOL, BRANDY, FERMENTATION, FUSEL OIL, GIN, STILL, &c.

DISTOMA. See FLUKE, ROT, TREMATODA, WORMS.

DISTORTIONS. In treating of this subject we shall confine ourselves to those distortions which are preventable—or rather, we may say, of two out of the three which will be discussed, which are voluntary.

One very common form of bodily distortion is crooked or curved spine. It is mostly met with in young girls of from 10 to 16 years of age; and

first shows itself either in the elevation of one shoulder above the other, or in a growing out of one of the shoulder blades, or of one side of the bosom beyond the other. The elevated shoulder is generally the right one. At the same time the right side of the chest is unnaturally high, and rounded; whilst the opposite or left shoulder and chest are on the contrary depressed and concave. Very frequently these conditions are accompanied by a projection of the left hip, and a curving inwards of the loins on the right side. With persons so afflicted the spine presents an appearance that has not inaptly been compared to a long italic *f* (*Blyth*).

Spinal curvature arises from a weakened state of the muscles, ligaments, and bones of the backbone. It is most frequently met with in those whose occupation compels them to stand the greater part of the day; as well as in persons who pass many hours at the desk or at needlework. Spinal curvature is also common in young fragile girls acting as nursemaids, and as such unduly subjected to carrying heavy infants on one side. Amongst the children of the poor, those of tender years are much too frequently put to this objectionable form of drudgery.

"Why one-sided postures should cause distortion must be evident, when it is considered that the intervertebral substance is compressible to such an extent that an adult man of middle stature loses about an inch of his height after having been in the erect posture during the day, and does not regain it till after some hours of rest. Since the united thickness of the intervertebral substance in an adult man is about 3·875 inches, we see that they lose nearly 1-4th by compression, which they do not recover till after some hours of rest. But if the weight of the body falls unequally on the spine day after day, it must be evident that they will become compressed on one side more than the other; and that if their elasticity be impaired, and the muscles and ligaments be weak, and the bones soft, as they are in young persons who have not a sufficiency of fresh air, wholesome food, and active exercise, this lateral distortion will become permanent" (*Dr Druitt*).

Another cause tending to distortion of the spine is the foolish habit of using corsets, a practice which contributes to weaken the dorsal muscles. When the shoulders are continually supported by a corset, the dorsal muscles upon which the support ought to fall have their functions usurped by the corset, and hence fail to receive their proper development, and consequently lose their power; the result being an inability on the part of the body to support itself without the corset, and a sinking and bending of the spine when it is removed. In boys, who never wear corsets, spinal curvature is rarely met with. In girls, who do, it is constantly to be found. To guard against spinal distortions, bad and awkward positions of the body should, wherever possible, be prohibited. Amongst the prejudicial postures indulged in by the young, we have already mentioned the habit of standing on one leg and of carrying heavy loads on one side of the body.

Every one-sided motion may lead to distortion if it be frequently repeated; and the tendency once existing, the evil grows day by day. The use of corsets should be strenuously discountenanced. The early detection of spinal distortion is a matter of considerable importance. Hence the advisability of mothers, nurses, governesses, and other guardians of children, or young girls, frequently examining the bodies of their charges to note if they present any of the peculiarities we have indicated at the commencement of this article. Should any of these develop themselves, aid should immediately be sought of a skilful medical practitioner.

Dr Lewis Sayre, in his work 'Spinal Disease and Spinal Curvature,' says:—"The great object in the treatment of Pott's disease is to maintain *rest of the affected part* by such means as will not debar the patient from the benefits of fresh air, sunlight, and change of scene. The patient should not be permitted to assume the upright position before he has been fitted with some artificial support capable of removing all pressure from the bodies of the diseased vertebræ. This object may be obtained by straightening the spinal column in such a manner that the weight of the body is borne by *the transverse* processes and not by the bodies of the vertebræ." Acting on these principles, Dr Sayre partially envelopes the patient in a jacket of plaster of Paris, surrounding the body from the pelvis to the axillæ.

Although Dr Sayre's work is almost entirely devoted to a much more serious affection of spinal curvature than that treated of here—viz. posterior angular curvature, in which actual disease of the bones of the vertebræ is concerned—his treatment is no less applicable to the milder form of distortion to which our remarks have been directed. Dr Sayre himself states that 300 cases have been treated by his method with very signal success, and very many eminent surgeons bear testimony to the soundness of the principles concerned in it. For the details of its application, consult the author's work before alluded to.

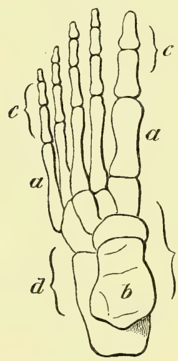
Serious as are the effects very frequently arising from spinal curvature, amongst which may be included lameness, lung disease, and inability to perform the functions of maternity; still worse results in addition to the two last of these ensue in the case of a persistence in another form of distortion, which is none the less dangerous because it is voluntary. The distortion to which we refer is that caused by the practice of tight-lacing.

Foremost among the conditions absolutely essential for the preservation of health and bodily well-being, is the due performance of the functions of the lungs, heart, liver, kidneys, stomach, and other important organs. The object of the ribs within which most of these organs are more or less wholly contained is to protect these latter from external pressure, and therefore injury; as well as to allow them unimpeded and unrestricted action. To ensure this freedom of movement for the parts and organs within the ribs, it will be evident that every possible obstacle tending in any degree to compress them, or circumscribe their limits should be especially avoided. The effects of tight-lacing are very extensive and but little realised. There are a number of ways in which damage may be done by tight-fitting garments

and accoutrements, which will be described under TIGHT-LACING.

Another variety of distortion is that brought about by wearing tight boots and shoes, or boots and shoes constructed upon false principles; for a boot or shoe may be productive of considerable inconvenience to the wearer, as well as the cause of a certain amount of twisting out of place of the bones of the foot, without necessarily being too small. Amongst the consequences arising from the adoption of tightly fitting or badly constructed boots or shoes may be mentioned the following:—Considerable bodily discomfort and pain in walking; corns and bunions; growing in of the nails; chronic enlargement of the base of the great toe; caries or ulceration of the bones of the feet; and flat feet. That these are not altogether minor evils may be inferred when it is stated that, in order to obtain relief from the effects of a bunion, partial amputation of the foot has been sometimes found necessary; that the first attacks of gout mostly seize the joint of the ball of the great toe when that joint has become weakened by displacement following the use of faulty boots and shoes; and that a flat foot interferes with the proper performance of walking.

FIG. 1.



The above figure (No. 1) represents the skeleton of the foot with the bones which form it in their natural position, and in which they are admirably adapted for executing the various movements required of them.

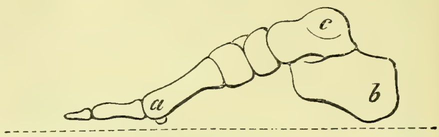
It will be seen to consist of 26 bones, 14 of which constitute the toes; the remaining 12 bones enter into the formation of what are termed the *tarsus* and *metatarsus*.

The 5 long bones (*a*) are the *metatarsal* bones. The toes form joints with the fore-part of these *metatarsal* bones. The remaining 7 are the *tarsal* bones; (*b*), which is one of these, is named *astragalus*, and being gripped on each side by a continuation from the bones of the leg called the *malleolus*, thus forms the ankle-joint.

Fig. 2 gives a representation of the inner aspect and side view of the foot. It will be seen that it is an arch resting in front on the anterior heads of the 5 metatarsal bones (*a*), but chiefly on that of the great toe, and on the *calcaneum* or heel (*b*) behind.

The astragalus (*c*) forms the key-stone of the arch. This arch, which supports the superincumbent weight of the body, retains its curved

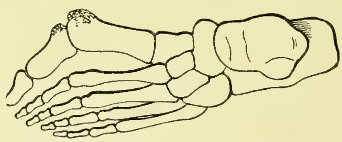
FIG. 2.



form by means of strong ligaments or bands, which unite the bones which compose it into a compact but withal flexible mass. The arch, owing to the pressure thrown upon it from above, becomes flattened when the foot is resting on the ground; but when this pressure is removed and the foot hangs free, the curvature of the arch increases. In front of the metatarsal bones are placed the toes, which are connected with the metatarsal bones by joints. The great toe has one joint; each of the smaller ones has two.

Fig. 3 depicts the skeleton of a foot with the bones thrown out of their natural position, the

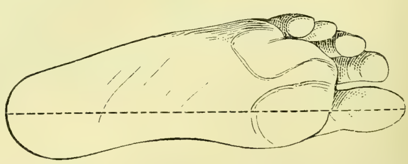
FIG. 3.



contortion being the result of wearing tightly fitting or unscientifically constructed boots or shoes. The following extracts from Dr Hermann Meyer will best illustrate how nature's simple mechanical arrangements must be thwarted when coverings for the feet are permitted to be constructed which can give rise to distortions such as those represented in Fig. 3. Dr Meyer says, "The great toe plays by far the most important part in walking; because when the foot is raised from the ground with the intention of throwing it forwards, we first raise the heel, then rest for a second on the great toe, and in lifting this from the ground the point of it receives a pressure which impels the body forwards. Thus, in raising the foot the whole of the sole is gradually, as it were, 'unrolled' up to the point of the great toe, which again receives an impetus by contact with the ground.

"The great toe ought, therefore, to have such a position as will admit of its being unrolled in the manner described; that is to say, it must so lie *that the line of its axis, when carried backwards, will emerge at the centre of the heel; and this is its position in the healthy foot.* The sole of an almost sound foot is given in Fig. 4, and

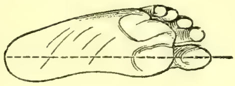
FIG. 4.



the true position of the great toe is indicated by

the dotted line. This relation is still better brought out in Fig. 5, which represents the well-preserved foot of a child about 2 years old. The line drawn through both figures is that in which the foot *unrolls* itself from the ground. The smaller toes, however, are by no means without their uses. In standing they rest on the ground,

FIG. 5.



and give lateral support to the foot; while in walking they are bent in a peculiar manner, so that they are firmly pressed against the ground; and here too they support the foot laterally. The first joint is strongly bent upwards, while the second is hollow above. This peculiar curvature enables the toe in a measure to lay hold of the ground as with bird's claws."

Dr Meyer then proceeds to show how the application of these principles is entirely disregarded in the manufacture of our boots and shoes, and to demonstrate that their neglect gives rise to the objectionable consequences we have before alluded to. As boots and shoes are at present constructed, the foot is made to adapt itself to the sole, not the sole to the foot. This pernicious system must be abandoned if we wish to preserve our feet, as well as our personal comfort.

"A sole," says Dr Meyer, "is of the proper construction when a line (see Fig. 6, *c d*) drawn at half the breadth of the great toe distant from, and parallel to, the inner margin of that toe shall, when carried backwards, pass through the centre of the heel. In the usual form of a sole this line passes out of the inner margin of the heel (see Fig. 7). If, then, the preservation of

FIG. 6.

FIG. 7.

primary straight line is, as has been already shown, the principal point in the formation of a proper sole, it follows that, if it be thought desirable to have pointed shoes, the pointing must be effected from the outer side as indicated in the annexed Fig. 8. In a pair of shoes made on these principles, placed side by side with the heels in contact, the inner margins of the front part of the foot are also brought close together" (Fig. 9).

Dr Meyer's pamphlet contains the following strictures on 'high heels' to boots and shoes:

FIG. 8.

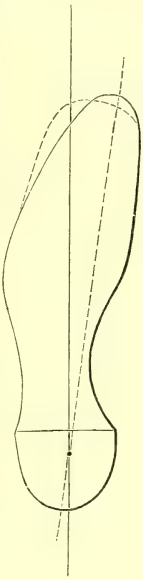
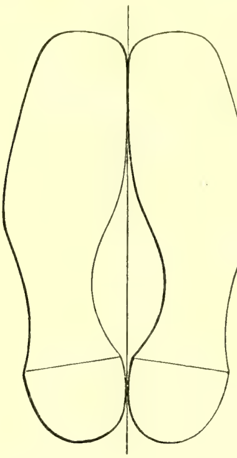


FIG. 9.



"It is usual, in all shoes of even moderate strength, to make the heel a little higher by means of what is called the *heel-piece*. These heel-pieces are generally of some little use, especially in dirty weather, and we cannot wholly deny their right to existence. But at the same time they ought to be as low as possible, and heels 1 inch thick, as is at present very commonly the case, have very serious disadvantages indeed.

"The weight of the body is by this means thrown in a disproportionate ratio on the toes, the joints of which are consequently overstrained. Moreover, with a high heel the sole is so oblique in its direction that the foot must be constantly gliding forwards and forcibly pressing the toes into the point of the shoe. The toes, therefore, even when the shoe is sufficiently long, are subjected to the same injuries and disfigurations as if it were too short, and the effects are doubly hurtful when the form of the sole is also incorrect. High heels, especially if they are also very small, are peculiarly liable to wear obliquely, and so the shoe gets trodden on one side; they must, therefore, be peculiarly favourable to origin of flat-foot.

"High and small heels are therefore quite unsuitable. The heel-piece ought to be as low and broad as possible."

Further and more explicit knowledge on this subject may be obtained from Dr Meyer's excellent little pamphlet entitled 'Procrustes ante portas,' very ably translated into English by Mr J. T. Craig, L.R.C.E., under the title of 'Why the Shoe Pinches.'

DITAINE. A crystalline alkaloid, obtained from the bark of *Alstonia scholaris*.

DIURE'SIS. See URINE.

DIURET'ICS. *Syn.* DIURETICA. Medicines which promote the secretion of urine. The principal diuretics are—aqueous fluids, which act by increasing the watery portion of the blood, and substances which promote the action of the kidneys. Most of the first produce copious diuresis if the skin is kept cool. Among the last are acetate, bitartrate, and nitrate of potassa; oils of juniper, turpentine, cajeput, and copaiba; dilute spirit, and sweet spirits of nitre; decoction of common broom, &c.

DIVIDIVI PODS. Fruit of *Cæsalpinia coriaria*, Willd. A powerful astringent, imported from South America and West Indies for the use of tanners; also from Maracaibo, Savanilla, and other parts. It contains above 5% of tannin; whilst gall-nuts contain less than 3·5%, and the best oak bark only 1·35%. Hence its value in tanning.

DOBEREINER'S LAMP. A portable apparatus for obtaining instantaneous light by the action of a jet of hydrogen on a small piece of spongy platinum.

DOCHMIUS DUODENALIS. An intestinal parasitic worm. Its length is from ⅓ to ½ an inch and its breadth about 1-60th of an inch. It is furnished with hooklets. It is found in the duodenum, the ileum, and the jejunum of man, and Greisinger seems to have pretty conclusively established that it is the cause of the disease so prevalent in Egypt, and known as the Egyptian chlorosis. Anæmia, dysentery, and hæmorrhoids and liver diseases are also frequently caused by it amongst the natives of Arabia, Brazil, and Northern Italy. In India it is also stated to give rise to some very alarming maladies. Leuchart affirms that it obtains an entrance into the system through drinking impure water.

DOC'IMACY or DOCIMAS'TIC ART. See ASSAYING.

DOG. The effect of medicines on dogs is much the same as on man; but there are some striking exceptions to this rule. Thus, whilst the dog can take a dose of aloes six or eight times as large as that given to man, the administration of half as much calomel or oil of turpentine would be productive of serious injury to the animal. The idea usually entertained, therefore, that medicines may be given to dogs in doses equalling those taken by man requires considerable modification. The facility with which dogs can be made to vomit is also another peculiarity possessed by them. Vomiting may be produced by their swallowing nauseous or unpalatable matters, as well as from their eating various sorts of grass. A good plan to prevent dogs vomiting their medicines is to keep the head well raised for an hour after the administration; and this may be easily accomplished by attaching a chain or cord to the collar, and fixing it at the requisite height to any object. The kidneys are acted upon with much more difficulty than with the horse, whilst the skin seems nearly, if not altogether, incapable of being affected. We give below a list of medicines for dogs; premising that the doses required vary considerably according to the strength, size, and age of the dog, all of which should always be duly taken into account. They are given rather with the idea of showing their composition than any recommendation of their use. The custom of physicking animals for every trifling ailment which, together with a similar treatment of the human subject prevailed years ago, is dying out. The non-professional reader is advised to consult the articles on the special diseases of dogs before attempting any treatment; or, better still, to seek the advice of some experienced veterinary surgeon. The doses prescribed in the following formulæ are for moderately large dogs:

PHYSIC BALLS AND OTHER PURGATIVE MEDICINES:

1. Barbadoes aloes, 8 oz.; antimonial powder, 1 oz.; ginger, 1 oz.; palm oil, 5 oz.; beat together into a mass.—*Dose.* From ½ dr. to 2 dr. every 4 or 6 hours, till the bowels are relieved (*Youatt*).

2. The same, with the addition of 1 oz. of calomel. He directs from 45 gr. to 2 dr. for a dose (*Clater*).

3. Aloes, ½ dr. to 2 dr. made into a ball with syrup of ginger.

4. Aloes, ½ dr. to 1½ dr.; calomel, 2 to 5 gr.; syrup to form a ball; in inflammation of the bowels and in worms (*Blaine*).

5. Cape aloes, ½ dr. to 1 dr.; calomel, 2 to 3 gr.; oil of caraway, 6 drops; syrup to form a ball (*M'Ewen*).

6. Calomel, 12 gr.; aloes, 3 dr.; opium, 1 gr.; syrup, q. s. to form a mass for 4, 6, or 8 balls; one every 4 or 5 hours till the bowels are relieved (*Blaine*).

7. Croton oil, 1 drop; Castile soap, 20 gr.; conserve to form a ball.

8. Castor oil, 3 parts; syrup of buckthorn, 2 parts; syrup of poppies, 1 part.—*Dose.* From 1 to 2 tablespoonfuls.—Mr Youatt's purge. [Mr Clark says syrup of buckthorn for dogs should be made with treacle, and the spices omitted.]

9. Epsom salts, from 1 to 4 dr., wrapped in tissue paper, dividing the doses into convenient sized packets.

10. In costiveness with inflammation: ½ oz. to 2 oz. castor oil (*Mr Spooner*).

ALTERATIVE BALLS AND POWDERS:

1. Sulphur, 2½ lbs.; nitre, ½ lb.; Æthiops mineral, 4 oz.; linseed meal, ½ lb.; palm oil, 1 lb., or as much as may be required; beat together, and keep in a jar for use.—*Dose.* From 2 scruples to 1½ or 2 dr. (*Clater*).

2. Æthiops mineral, 20 to 40 gr.; cream of tartar, 20 to 40 gr.; nitre, 5 to 10 gr.; night and morning, made into a ball with butter (*Spooner*).

3. *Tonic Alterative.* Mercurial pill, 1 dr.; aloes, 2 dr.; myrrh, benzoin, balsam of Peru, of each, 1½ dr.; to be divided into 10, 15, or 20 pills; one every evening, for the yellows, after aloes and calomel (*Blaine*).

4. *Alterative Powder.* Æthiops mineral, 2 to 5 gr.; cream of tartar, 4 to 10 gr.; tartarised iron, 1 to 3 gr., once a day (*Clater*).

5. *To give a Fine Skin.* Give a tablespoonful of tar made up with oatmeal (*Mayer*).

ASTRINGENT BALLS, &c.:

1. Catechu, 1½ dr.; sulphate of quinine, 20 gr.; opium, 5 gr.; ginger, 1 dr.; conserve of

roses, q. s. to form a mass, to be divided into 8, 6, or 4 balls (*Blaine*).

2. Prepared chalk, 2 oz.; powdered gum-arabic, ½ oz.; powdered catechu, ½ oz.; powdered oak bark, ½ oz.; powdered ginger, ¼ oz.; opium, 15 gr.; palm oil, 1 oz.; beat well together.—*Dose*, ½ dr. to 2 dr., morning, noon, and night, in the advanced stage of distemper (*Clater*).

3. Opium, 5 gr.; catechu, 2 dr.; gum-arabic, 2 dr.; ginger, ½ dr.; syrup of poppies, q. s.; divide into 12, 9, or 6 balls; in diarrhœa (*Blaine*).

4. Myrrh, 1 dr.; ipecacuanha, 1 scruple; opium, 3 gr.; chalk, 2 dr.; carbonate of iron, 1 dr.; as No. 3 (*Blaine*).

5. In obstinate cases: Alum, 1 dr.; chalk, 2 dr.; opium, 6 gr.; resin, 3 dr.; into 4, 6, or 8 balls.

6. In diarrhœa, after 1 to 4 dr. of Epsom salts; prepared chalk, 1 to 3 scruples; catechu, 5 to 10 gr.; opium, ¼ to 2 gr.; twice a day (*Spooner*).

COUGH BALLS IN ASTHMA, &c.:

1. *After a few Emetics.* Calomel, 3 gr.; foxglove, 3 gr.; cream of tartar, 1 dr.; antimonial powder, 12 gr.; honey to form 6 boluses. One twice a day (*Blaine*).

2. Digitalis, 20 gr.; antimonial powder, 40 gr.; nitre, 2 dr.; sulphur, 3 dr.; palm oil, 3 dr., or q. s. Divide into 10, 15, or 20 balls, according to the size of the dog, morning and night, interposing an emetic every third or fourth day (*Clater*).

3. *In Old Cases.* P. squill, ½ gr. to 1 gr.; gum-ammoniac, 5 gr.; balsam of Peru, 8 gr.; benzoic acid, 1 gr.; balsam of sulphur to form a ball.

4. Extract of hemlock, ½ dr.; extract of henbane, 10 gr.; p. digitalis, 20 gr.; conserve of roses to form a mass. Divide into 8, 10, or 6 balls. One night and morning (*Blaine*).

DISTEMPER MEDICINES:

1. Turbeth mineral, 1 to 3 gr.; assafœtida, ½ dr.; aloes, 20 gr.; soap, 10 gr.; syrup of poppies to form a ball. To be preceded by an emetic, and given every third day.

2. After an emetic give a physic ball; and afterwards the following, two or three times a day:—Antimonial powder, 2, 3, or 4 gr.; nitre, 5, 10, or 15 gr.; ipecacuanha, 2, 3, or 4 gr.; form a ball. If the disease proceed to the debilitating stage, give the *tonic ball* No. 2; in the putrid or malignant stages give the *astringent ball* No. 1 (*Blaine*).

3. After the Emetic Powder No. 1 (which should be repeated every 3rd or 4th day) give the *cough ball* No. 2, from ½ dr. to 2 dr. in weight. And if the dog lose flesh, give equal parts of the cough ball and the tonic ball (No. 1). In the more advanced stages give the tonic alone; or the *astringent ball* if diarrhœa comes on (*Clater*).

4. Give a third of a paper of James's powder mixed with butter, and afterwards warm broth or milk. In 2 hours, another third; and if this neither vomit nor purge, give the other third at the end of 4 hours (*Daniel*).

5. Blaine's distemper powders, which are sold in packets, with directions for use.

6. Camphor, 3 to 5 gr.; charcoal, 10 gr.; opium, 1 gr.; aromatic confection, q. s. to form a ball. In the malignant stage, with diarrhœa.

7. Antimonial powder, 2 to 4 gr.; nitre, 5 to 10 gr.; digitalis, ¼ to 2 gr. Afterwards the tonic pills No. 4 (*Spooner*).

Poudre Kusique: a French nostrum. Mix 45 gr. of nitre, 45 gr. of sulphur, and 1 gr. charcoal. Divide into 3 doses. Give one for two successive mornings, and the third on the fourth morning, mixed with lard or butter, or in milk. For a large dog a second packet (of 3 powders) may be required (*Habert*).

Another French nostrum, Hemel's powder, is of a similar kind.

8. A strong solution of salt, to the amount of ½ pint daily.

9. Powdered tin, sulphur, gunpowder, of each, 1 oz.; lard sufficient to form a mass. The size of a nutmeg to be given twice or thrice a week.

10. Physic ball No. 11.

11. ¼ oz. to 1 fl. oz. of cod-liver oil twice a day, according to size.

12. Emetics, gentle laxatives, milk diet, and from 5 to 15 gr. of chlorate of potash twice a day (*Finlay Dun*).

WORM MEDICINES:

1. Carbonate of iron, ½ oz.; Æthiops mineral, 1 dr.; gentian, 1 oz.; ginger, ½ oz.; levigated glass, 1 oz.; palm oil, 9 dr.; beat well together.—*Dose.* From ⅔ to 2 dr. (*Clater*).

2. As much very finely-powdered glass as will lie on a sixpence, mixed with butter (*Blaine*). Mr Youatt says from ½ dr. to 1 dr.; powdered glass, with a little ginger, made into a ball with lard.

3. Aloes, sulphur, prepared hartshorn, and juice of wormwood, made into a mass; the size of a hazel-nut to be given three times a week, fasting, wrapped in butter (*Daniel*).

4. Tin filings, or pewter filings, ½ dr. to 1 dr., with butter or lard.

5. Jalap, 10 to 15 gr.; calomel, 2 to 3 gr. mixed with butter; no cold liquid should be allowed (*White*).

6. Cowhage, ½ dr.; iron filings, 4 dr.; conserve q. s. to form a mass, to be divided into 4, 6, or 8 balls; one every night and morning; and afterwards the purgative No. 4 (*Blaine*).

7. Epsom salts, 1 oz.; common salt, 1 dr.; give a small or large teaspoonful daily.

8. Give green walnut leaves boiled in milk. (*Meyer*).

9. From ½ dr. to 2 dr., according to size. Betel nut in coarse powder, made into a ball.

10. *For Tapeworm.* Oil of turpentine, ½ dr., mixed with yelk of egg; for very large dogs, 2 scruples. Some writers prescribe larger doses (1 to 2 dr.), but these sometimes prove fatal (*Blaine*). 2 to 6 dr. of cusso according to size.

11. *For Tapeworm.* Oil of turpentine and olive oil, of each, ½ oz.; mix and give carefully; 3 or 4 hours after give 1 oz. castor oil. But see No. 9 (*White*).

12. *For Stomach Worms.* Give the emetic powder (see further back), and afterwards a physic ball.

13. *Threadworms.* These are destroyed by an aloetic clyster.

OINTMENTS AND LOTIONS FOR THE MANGE:

N.B. An alterative ball should be given daily and a physic ball occasionally.

For Scabby Mange. Sulphur, 4 oz.; sal ammoniac, ½ oz.; aloes, 1 dr.; Venice turpentine, ½ oz.; lard, 6 oz.; mix. After 4 applications, wash well with soap and water (*Blaine*).

2. Horse turpentine and palm oil, of each, ½ lb.; train oil, 1 pint. Melt together, and while cooling, stir in 3 lbs. of flowers of sulphur (*Clater*).

3. Aloes, 2 dr.; hellebore, ½ oz.; sulphur, 4 oz.; lard or train oil, 6 oz. (*McEwen*).

4. Sulphate of zinc, 1 dr.; snuff, ½ oz.; white hellebore, ½ oz.; sulphur, 4 oz.; aloes, ¼ oz.; soft soap, 6 oz. (*Blaine*).

5. Charcoal powder, 2 oz.; sulphur, 4 oz.; salt of tartar, 1 dr.; Venice turpentine, ½ oz.; lard, 6 oz.

6. *For Red Mange.* Add 1 oz. of strong mercurial ointment to 6 oz. of either of the above.

7. Charcoal, 1 oz.; chalk, 1 oz.; sugar of lead, 1 dr.; white precipitate, 2 dr.; sulphur, 2 oz.; lard, 5 oz. (*Blaine*).

8. *Wash for Red Mange.* Corrosive sublimate, 20 gr.; spirit of wine, 2 dr.; dissolve and add milk of sulphur, ½ oz.; lime-water, ½ pint. Apply by means of a sponge (*Clater*).

9. *For Ulcerated Mange.* Ointment of nitrated quicksilver, 2 dr.; sugar of lead, 20 gr.; flowers of sulphur, ½ oz.; lard, 1 oz.; mix (*Blaine*).

10. The editor has treated several bad cases of mange in dogs as follows:—Boil in an iron pot water, 1 quart; washing soda, about ¼ lb.; and flowers of sulphur, q. s., until a deep orange liquor is obtained, smelling strongly of sulphuretted hydrogen; pour off a little of the clear liquor and work it up to a lather with soft soap, and rub the affected part thoroughly with it, care being taken to avoid any very raw places. The dressing is absorbed, and acts as a gentle purgative. The dog should be kept apart while under treatment, as the odour is offensive. Wash well after 24 hours, and repeat the treatment at intervals. Watch the animal, and stop the treatment if there is much diarrhœa or irritation. The lather should be rubbed on with the bare hand.

FLEAS:

1. Rub the skin with powdered resin and bran.

2. Let the dog sleep on deal shavings.

3. Scotch snuff steeped in gin (*Meyer*). (This requires caution.)

4. Oil of aniseed (*Finlay Dun*).

5. Persian insect powder.

6. Clean bedding, and frequent washing with water containing a little Jeye's purifier.

DOG-BALLS (*A. H. Bôldt*, Genf.). Hard pills, weighing ·15 grms., of irregular shape and unequal size, composed of aloes with 1-3rd of gentian, and covered with a brown powder containing liquorice root (*Hager*).

DOGWOOD of Tasmania (*Bedfordia salicina*, DC.). A shrub 12 to 14 feet high. The wood is beautifully marked and is used in cabinet work.

DOLICHOS BIFLORUS, L. Horse gram. An East Indian food-plant.

DOLICHOS LABLAB, L. Wall. A climbing perennial, or under cultivation an annual, common in India. The seeds vary in form and colour and are largely used as food.

DOORS. Much annoyance is sometimes experienced from the creaking of doors. This may be prevented by rubbing a little soap or a mixture of tallow and black-lead on the hinges, or by applying to them with a feather a little sweet oil once or twice a year. The trifling trouble will be amply repaid by their noiselessness and greater durability. To prevent the noise of doors slamming, a small piece of vulcanised india rubber, cork, or leather may be placed so as to receive the shock.

It is a good plan sometimes to take a door off its hinges and rehang it. The warping of the frame or a slight alteration of shape due to the 'giving' of the wood, often causes doors to jam or to refuse to remain closed. No amount of tampering with the lock is of any avail, a re-setting of the hinges and a little packing placed under them will often make a door fit well and easily.

DOREMA ROOT. See GUM AMMONIACUM.

DOSE. In *medicine*, the quantity taken or prescribed at one time. The doses of medicaments vary with the sex, age, temperament, constitutional strength, habituation, and idiosyncrasies of individuals. Different circumstances, especially of climate, exercise an important influence on the activity of medicines. Thus, the inhabitants of England and the northern countries of Europe bear much larger doses in their own climates than when they remove to warmer latitudes. Warmth, indeed, appears to promote the action of most medicaments, whilst cold acts in a contrary way. Nor does the same rule apply to all medicines. Calomel, for instance, is generally borne better by children than by adults; while opium affects them more powerfully, and requires the dose to be diminished considerably below that indicated by mere calculation or analogy with other medicines.

Prescribers ought not to forget that the action of medicines is not simply proportioned to the amount, but that each remedy has a dose below which it either produces no effect or one contrary to that which we desire it to produce. Dr Paris remarks, "that powerful doses are disposed to produce local rather than general effects;" and Dr Barlow gives it as his opinion that "practitioners often err, especially in the treatment of chronic maladies, from requiring an obvious effect from each dose administered." Adult women are said to require only 3-4ths the full dose for men. The following rules and tables have been framed chiefly with reference to age; but as Dr R. E. Griffith correctly observes, "no scheme can be devised, founded on age alone, to which there are not many exceptions."

I. *Formula of* Dr YOUNG.

For children under 12 *years, the doses of most medicines must be diminished in the proportion of the age to the age increased by* 12. Thus, at 2 years the dose will be 1-7th of that for an adult.

$$\text{for } \frac{2}{2+12} = 1\text{-}7\text{th}.$$

II. *Posological Table of* Gaubius.

For an adult, suppose the dose to be 1, or 1 dr. (60 grs.).

Under	1 year will require		$\frac{1}{12}$ or 5 gr.
„	2 years	„	$\frac{1}{8}$ or 8 gr.
„	3 „	„	$\frac{1}{6}$ or 10 gr.
„	4 „	„	$\frac{1}{4}$ or 15 gr.
„	7 „	„	$\frac{1}{3}$ or 1 scr.
„	14 „	„	$\frac{1}{2}$ or $\frac{1}{2}$ dr.
„	20 „	„	$\frac{2}{3}$ or 2 scr.
„	21 to 60, the full dose, or		1 or 1 dr.

Above this age an inverse gradation must be observed.

III. *Posological Table of* Phoebus.

Age—*Years*	80	65	50	25–40	20	16	12	8	5	2
Doses	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{4}$
„ *Months*	12	6	2	1						
Doses	$\frac{1}{5}$	$\frac{1}{8}$	$\frac{1}{15}$	$\frac{1}{24}$						

DOUCHE. [Fr.] *Syn.* Douche bath. A species of bath much employed by hydropathists, both for the relief of local affections, and to give a healthy stimulus to the whole system. The douche consists of a single jet of cold water, varying in size from the thickness of a quill to that of a man's arm; it is projected with great force, either from above, below, or on one side, upon a particular part of the body. See Bath (Shower).

DOUGLAS' DISINFECTING POWDER. A mixture of sulphite of calcium, chalk, and carbolic acid, or of sulphite and carbonate of lime.

DOUNDAKÉ (*Sarcocephalus esculentus*, Afz.). [*Cephalina esculenta*, Schum. and Thonn.], or Negro peach of Sierra Leone. The tree yields a yellow dye and a bitter astringent alkaloid, said to be a powerful antipyretic like quinine.

DOVER'S POWDERS. See Powder.

DRAB DYE. 1. (For Cotton.) For 40 lbs. Boil 6 lbs. of fustic; scald $2\frac{1}{2}$ lbs. of Lima wood and 2 lbs. of sumach. Decant into a wooden vessel capable of containing 100 galls.; reduce with cold water to handling heat; enter, 6 turns; wring out; sadden with 8 oz. of copperas; 4 turns; wring out again, and give 4 oz. of bluestone.

2. (For Silk.) For 100 yards. Boil 4 lbs. of fustic and 6 oz. of logwood, $2\frac{1}{2}$ oz. of cudbear, $1\frac{1}{4}$ oz. of copperas. Cool to 200° F.; enter, winch 20 minutes; air out; repeat; then take a little liquor out of the boiler, dissolve the copperas, reduce it to handling heat with water, and give one or two shots through it, as the pattern requires; one water out of the saddening; then give a warm but weak sour to clear the colour, wash in two waters, and dry.

3. (For Wool.) *Dark drab.* For 50 lbs. 7 lbs. of fustic, 8 oz. of madder, 4 oz. of cudbear, 2 lbs. of alum, 8 oz. of tartar. Enter between the cold and 160° F.; after heating up boil from 10 to 30 minutes; wash in two waters. All dark shades of this may be slightly prepared with chrome; wash in two waters.

4. (For Wool.) *Light drab.* For 56 lbs. 4 lbs. of fustic, $1\frac{3}{4}$ lbs. of alum, 4 oz. of madder, 4 oz. of tartar, $3\frac{1}{2}$ oz. of cudbear. Work as for dark drab.

DRACONINE. *Syn.* Dra'cine, Red resin of dragon's blood. A peculiar vegetable principle discovered by M. Melandre in dragon's blood.

Prep. Dragon's blood is dissolved in alcohol, the solution filtered, concentrated, and precipitated with cold water; the red, spongy precipitate is well washed, neutralised with dilute sulphuric acid, again liberated by means of an alkali, and well washed with water.

Prop., &c. Draconine has a fine red colour; is tasteless, inodorous, and flexible; it fuses at 131° F. The smallest quantity of carbonate of lime in filtering paper may be detected by sulphate of draconine, the yellow colour instantly turning red.

"DRAGÉES AU LACTATE DE FER." (*Gélis* and *Conté.*) 100 grms. of lactate of iron made into 2000 very small pills with powder and mucilage of marshmallow, and coated with eleosaccharate of anise (*Reveil*).

DRAGÉES DE COPAHU DE FORTIN. 30 grms. balsam of copaiba made into 72 dragées, with 1·2 grms. calcined magnesia, and coated first with gum-arabic and then with sugar (*Reveil*).

DRAGÉES DE CUBEBE AU COPAHU. Cubebines. (*Labelonye.*) 2 parts balsam of copaiba, 2 parts extract of cubebs, 1 part yelk of egg, with sufficient liquorice powder to make a mass, which is divided into oblong pills, each weighing 7 decigrms. These are dried and coated with white or raw sugar (*Hager*).

DRAGÉES DE POUGUES. (*Garnier.*) Chloride of calcium, 50 parts; chloride of magnesium, 50 parts; chloride of iron, 10 parts; dissolved in water and precipitated with sodium carbonate. The precipitate is washed, pressed, and mixed with 100 parts bicarbonate of soda. Of this mixture 25 parts are made into a mass with 475 parts of a paste of sugar, peppermint, oil, and mucilage. The mass is then divided into dragées weighing 5 decigrms., which are coated with gum and sugar (*Reveil*).

DRAGON'S BLOOD. *Syn.* Sanguis draconis, L. A rich red-coloured resin, obtained from various species of the genera *Calamus* and *Dracæna* Its colour, in the lump, is a dark brownish-red; in powder, bright red. It is friable, breaks with a shining fracture, and has a sp. gr. not higher than 1·196 or 1·197. There are four distinct varieties of red resin sold as dragon's blood. One variety is brick red; melts about 80° C.; gives off red-coloured highly irritating fumes when decomposed by heat; soluble in alcohol, ether, carbon bisulphide, and benzene. A second kind is carmine; red in colour; melts about 100° C.; dissolves in alcohol and ether, but is insoluble in carbon bisulphide and benzene. A third variety is of a vermilion colour; melts about 80° C.; soluble in alcohol and ether; insoluble in chloroform, carbon disulphide, and benzene. A fourth variety is a mixture in varying proportions of a reddish-brown resin, freely soluble in carbon bisulphide, and a light brick-coloured resin, nearly insoluble in carbon bisulphide. When pure, it readily dissolves in alcohol, ether, and oils, yielding rich red, transparent solutions. Adulterated and factitious dragon's blood is only partly soluble, and lacks the rich colour of the genuine artice. Dragon's blood is chiefly used to tinge varnishes and lacquers.

Dragon's Blood, Factitious. *Prep.* 1. Shell-lac, 4 lbs.; melt, remove from the fire, and add, Canada balsam, 6 oz., and gum benzoin, 2 oz.; mix well, stir in red sanders wood, $1\frac{1}{2}$ lbs., and Venetian red, $\frac{3}{4}$ lb. (both in fine powder); and form the mass into sticks.

2. As the last, omitting the red Venetian.

DRAINS. The salubrity of a dwelling-house is largely dependent upon the sound condition, the unimpeded outlet from, and the proper construction and position of, its drains, supplemented by like conditions in the various house-pipes which run from the sinks and closets into them.

The sense in which we shall use the term 'drain' is that defined by the Public Health Act of 1875:—"'Drain' means any drain of, and used for the drainage of one building only, or premises within the same curtilage, and made merely for the purpose of communicating therefrom with a cesspool or other like receptacle for drainage, or with a sewer into which the drainage of two or more buildings or premises occupied by different persons is conveyed."

The conditions which should be fulfilled by house drains are the following:

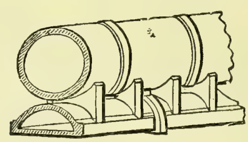
They should be entirely outside the house if possible, and in any case so arranged that they may be easily inspected throughout their whole length. They should be made of good glazed sanitary pipes, set in a thick bed of clay or concrete, so that in case of leakage the surrounding soil shall not be polluted by sewage. The system should be as simple in form as possible; no curves or bends or junctions should be allowed except those which are absolutely necessary, and, in a properly built house, the water-closet, bath, and kitchen sinks should all be on the same *outside* wall so that a perfectly straight drain may be laid outside the house with which these can be made to communicate in as simple and direct a manner as possible. Where each house has a separate drain, a pipe with ventilating cowl should be fixed at the blind end of the drain and carried up to the roof. There should also be a good ventilation between the house and the sewer. The closet soil-pipe should have a separate junction with the house-drain and should be carried up to the roof so as to prevent the possibility of sewer gas finding its way into the house through the closet siphon which might be drawn or forced by some sudden change of pressure in the drain. The kitchen sink and bath waste should not communicate directly with the sewer, but should discharge into a grating furnished with a proper trap. In this way the house is cut off from all direct communication with the sewers.

The kitchen sink trap is apt to become clogged with grease. This should be carefully watched and cleaned out regularly. Boiling water, followed by a quantity of a strong hot solution of washing soda, will generally clean out the grease effectually. In hot weather a handful of crystals of sulphate of iron occasionally thrown into the traps and gullies is an excellent purifier, and where there is a bath the discharge of the waste is an excellent means of flushing.

The best material for the manufacture of drain pipes is hard, well-burnt, smooth, and glazed earthenware; bricks and porous earthenware are particularly ill-adapted for the purpose; so also are iron pipes, unless they are thoroughly cemented inside.

In the laying of drain pipes care should be taken to place them on concrete, in loose soils, and on well-worked puddled clay, in the case of clay soils. When they are laid in very loose soils it is some times necessary, besides employing concrete, to additionally use even piling for the depth of a foot. Leakage and consequent soakage of the soil are sure to take place sooner or later if the drain pipes are not laid on a good foundation, as they are when the drains are badly and carelessly joined.

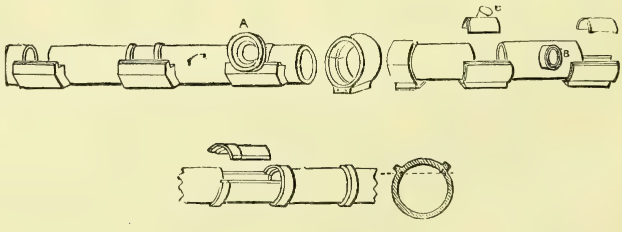
Messrs Brooke, of Huddersfield, have invented a combined drained and subsoil pipe, the latter,



on which the drain pipe rests, being perforated, carries off the subsoil water. This contrivance is adapted for wet soils.

When junction pipes are required for uniting the drain pipes, those known as 'oblique junctions' only should be used. The junctions known as 'square junctions' should be avoided, as they are always sure to become blocked up.

With respect to the fall of drain pipes, Dr Parkes says, "1 in 48 is frequently given, or 3-4ths



of an inch in every yard; a fall of 1 in 65 in drains of 6 inches diameter, and 1 in 87 in drains of 8 inches diameter, will give a velocity of 220 feet per minute."

In order that drain pipes may be properly cleaned it is desirable to have them so made that they can be opened at intervals by means of lids or caps. The preceding cuts represent a few of

the many kinds of pipes adapted for this purpose.

In addition to this method of cleansing them, drain pipes should be regularly flushed out at least once a month. House pipes are usually cleaned out by means of a flexible bamboo, or by jointed rods fitted with screws and rollers, which serve to loosen sediment. A frequent examination of all house pipes and traps should be made, and every joint and bend of the former well looked to. Unfortunately, however, they are so frequently covered in that this is impossible.

Where it can be done all skirting boards and covers under which the pipes and traps are concealed should be removed. When, however, this cannot be managed the following plan of examination into their condition may be followed:—Pour water down the pipe, and observe if there be any smell; if there be, the pipe is full of foul air, and requires ventilation; or else the trap is defective, and the bad smell is due to sewer gas. Or, instead of pouring down water, a lighted candle or a piece of smouldering brown paper may be held over the entrance of the pipe, or the grating over a trap, when the air will be driven back. If the condition of the pipe be tested by throwing water down it, it should be noticed whether the water runs away at once or whether it is checked in its progress. This is all that, under the circumstances, can be done inside the house; but though an examination of the pipe is precluded inside, it may be possible to remove the earth on the outside, and so to get down to and open the drain with which the pipe communicates. Under these circumstances, water mixed with lime should be poured down the house pipe; if the milky-looking water is long in making its appearance, and runs only in driblets, the drain requires flushing; if the milky-looking water is much coloured and mixed with dirt, then the pipes and trap are foul, or there is a sinking or depression in some part of the drain where the water is lodging.

Afterwards a pailful of lime and water should be poured down the pipe, which should be afterwards flushed by pouring water down it until the water flows off nearly clear.

Referring to the construction and position of the pipes which carry off the waste water, soil, &c., from our houses into the drains, Dr Parkes writes—"Builders are always anxious to conceal tubes, and thus carry them inside the walls, or in the case of hollow walls, between the two. The consequence is that any escape of air must be into the house. I have known a case in which the leakage of a closet pipe carried down in a hollow wall constantly contaminated the air of a house. It would be infinitely better to run the pipes at once through the wall to the outside. Few persons have any idea of the carelessness of plumbers' work—of the bad junctions, and of the rapidity with which pipes get out of order and decay. When a leaden pipe carrying water is led into a water-closet discharge pipe, it is frequently simply puttied in, and very soon the dried putty breaks away, and there is a complete leakage of gas into the house. Even if well joined the lead pipe will, it is said, contract and expand, and thus openings are at last formed. Dr Fergus, of Glasgow, has directed particular attention to this in the case of lead closet pipes, which become easily perforated, and which have only a limited duration of wear." See TRAPS, SEWERS, WATER CLOSETS, WATER SUPPLY.

DRAUGHT. *Syn.* HAUSTUS, L. A single dose of liquid medicine, usually dispensed in 1½-oz or 2-oz. phials. Draughts are almost exclusively extemporaneous compounds, and differ from 'mixtures' only in containing one dose; whereas mixtures contain several. The latter have now very generally superseded draughts among all but the higher classes, when the dose is to be frequently repeated. Draughts possess the advantages of extreme convenience, and, from only one phial being opened at a time, of preserving the preparation better than when it is exposed to the air by the frequent removal of the cork. They are usually taken from a wine-glass, which they about 2-3rds fill.

In the preparation of draughts the same precautions are observed as are pointed out under MIXTURE; regard being had to the increased volume of the dose. The ingredients of a 6-oz. mixture, for example, containing (say) 12 doses, may be equally distributed among a dozen draught phials, after which each may be filled up with distilled water, or any other simple vehicle. In most cases a little syrup may be advantageously added. In many instances no addition will be required, the doses of each form of preparation being the same.

The following are useful formulæ, which will serve as examples for others of the class. The number might be easily multiplied, and, indeed, might be extended so as to include 3-4ths of the whole materia medica; but such a plan would lead to useless repetitions, and occupy much space. See MIXTURE, PRESCRIBING, &c.

Draught, Abernethy's. See ABERNETHY MEDICINES and MIXTURE.

Draught, Acetate of Ammo″nia. *Syn.* HAUSTUS AMMONIÆ ACETATIS, L. *Prep.* 1. (St. B. Hosp.) Solution of acetate of ammonia, 4 fl. dr.; water to make 1½ fl. oz.

2. (*Dr Paris.*) Camphor mixture, 1½ fl. oz.; liquor of acetate of ammonia, 4 fl. dr.; antimonial wine, 20 drops; mix. As a refrigerant and diaphoretic in febrile affections; taken late in the evening.

Draught, Ac′etate of Potas′sa. *Syn.* HAUSTUS POTASSÆ ACETATIS, L. *Prep.* (Mid. Hosp.) Acetate of potassa, 30 gr.; bicarbonate of potassa, 20 gr.; peppermint water, 1 fl. oz. Diuretic, antacid, and laxative.

Draught, Ammoni′acal. *Syn.* HAUSTUS AMMONIACALIS, H. AMMONIÆ, L. *Prep.* (*Brande.*) Liquor of ammonia, 20 to 30 drops; compound tincture of cardamoms and tincture of gentian, of each, ½ fl. dr.; camphor mixture, 1½ fl. oz. An aromatic absorbent and stomachic; in heartburn, acidity, low spirits, &c.

Draught, Anodyne. *Syn.* HAUSTUS ANODYNUS, L. *Prep.* 1. Tincture of opium, 15 drops; pimento water and syrup of poppies, of each, 2 dr.; water, 1 fl. oz.

2. (*Copland.*) Nitre, 6 gr.; laudanum, 12 drops; compound spirit of ether, 1 fl. dr.;

syrup of poppies, 2 fl. dr.; camphor mixture, 9 fl. dr.

3. (*Ellis.*) Tincture of opium, 15 to 25 drops; syrup of poppies, 2 fl. dr.; spirit of cinnamon, 1 fl. dr.; distilled water, 1½ fl. oz.

4. As the above, but substituting a like quantity of solution of either acetate or hydrochlorate of morphia in lieu of the laudanum. All the above are given as soothing draughts to allay pain and produce sleep, especially the last thing at night. No. 4 is to be preferred if there are febrile symptoms present.

Draught, Antac′id. *Syn.* Haustus antacidus, L. *Prep.* 1. Bicarbonate of soda, 20 gr.; tincture of calumba, 3 fl. dr.; tincture of hops, 1 fl. dr.; syrup of orange peel, 2 fl. dr.; water, 6 fl. dr. To improve the appetite in heartburn and dyspepsia; taken 1 hour before a meal.

2. Liquor of ammonia, 16 drops; syrup of saffron, 2 fl. dr.; infusion of gentian, 3 fl. dr.; water, 7 fl. dr. As the last, taken occasionally, especially in debility, low spirits, &c.

3. (*Collier.*) Compound tincture of cardamoms, 1 fl. dr.; solution of bicarbonate of magnesia (fluid magnesia), 9 fl. dr.; simple syrup, 2 fl. dr. Twice a day; in dyspepsia, heartburn, &c., especially in gouty patients.

4. (*A. T. Thomson.*) Magnesia, 1 dr.; peppermint water, 1½ fl. oz.; tincture of orange peel, 1 fl. dr. In dyspepsia, &c., with acidity or diarrhœa.

5. As No. 1, but using bicarbonate of potassa for bicarbonate of soda. In acidity, diarrhœa, &c., accompanied by great irritability of the stomach.

6. Prepared chalk, 30 gr.; spirit of nutmeg and tincture of opium, of each, 12 to 20 drops; syrup of saffron, 3 dr.; cinnamon water, 1 fl. oz. In acidity, with extreme looseness of the bowels.

Draught, Anti-arthrit′ic. *Syn.* Haustus anti-arthriticus, L. *Prep.* 1. Tincture of colchicum seeds (L.), ½ fl. dr.; syrup of orange-peel, 2½ fl. dr.; water, 1 fl. oz. In gout; taken overnight, followed by another in the morning.

2. (*Brande.*) Wine of colchicum, ½ fl. dr.; carbonate of magnesia, 15 gr.; cinnamon water, ½ fl. oz.; water, 1 fl. oz. As the last.

3. (*Sir C. Scudamore.*) Magnesia, 18 gr.; Epsom salts, 1½ dr.; vinegar of colchicum, 1 fl. dr.; simple syrup, 1 fl. dr.; cinnamon water, 9 fl. dr. As the last.

4. (*Sir H. Halford's* Gout Preventive.) Compound infusion of gentian, 1½ fl. oz.; tincture of rhubarb, 1 fl. dr.; bicarbonate of potassa, 15 gr.

Draught, Anti-asthmat′ic. *Syn.* Haustus anti-asthmaticus, L. *Prep.* Vinegar of squills, ½ fl. dr.; ipecacuanha wine, 15 drops; cinnamon water, 1½ fl. oz. Expectorant. One to be taken 3 times daily during the attack.

Draught, Anti-emet′ic. *Syn.* Haustus anti-emeticus, L. *Prep.* 1. Juice of 1 lemon; liquor opii sedativus, 10 drops (or laudanum, 15 drops); ether, 20 drops; simple syrup, 2 dr.; water, q. s.

2. (Haustus anti-emeticus Riverii, P.C.) Bicarbonate of potassa, 30 gr.; lemon juice, 4 dr.; syrup of lemon, 1 oz.; water, 3 oz.; mix quickly, and tie down the cork. To check nausea and vomiting. This is best given effervescing.

Draught, Anti-hyster′ic. *Syn.* Haustus anti-hystericus, L. *Prep.* Cyanide of potassium, 1 gr.; lettuce water (distilled), 2 fl. oz.; syrup of orange flowers, 1½ oz.; water, 5½ fl. oz.; for 6 draughts. One to be taken when the fit is expected, and a second in ½ hour. Should the fit come on, the dose may be repeated at intervals of about 15 minutes, until 3 or 4 have been altogether administered. The symptoms, however intense, are generally either at once arrested or greatly alleviated by this treatment.

Draught, Antilith′ic. *Syn.* Haustus anti-lithicus, L. *Prep.* 1. (*Venables.*) Borax, 8 gr.; bicarbonate of soda, 10 gr.; aërated water, 8 fl. oz. For a draught; in red gravel.

2. (*Dr Paris.*) Carbonate of soda, 12 gr.; tincture of calumba, 1 fl. dr.; infusion of quassia, 1 fl. oz.; water, 3 fl. dr. In dyspepsia and gravel, attended with the lithic-acid diathesis.

Draught, Anti-neural′gic. *Syn.* Haustus anti-neuralgicus, H. narcotinæ, L. *Prep.* (*Jeston.*) Narcotine, 2 gr.; diluted sulphuric acid, 20 drops; infusion of roses, 1½ fl. oz. One every 2 hours in the intermissions of neuralgia.

Draught, Antisep′tic. *Syn.* Haustus anti-septicus, L. *Prep.* (*Dr Collier.*) Decoction of yellow bark, 1 fl. oz.; tincture of opium, 5 drops; spirit of pimento and water, of each, 2 fl. dr. In putrid fevers, gangrene, &c.

Draught, Antispasmodic. *Syn.* Haustus anti-spasmodicus, L. *Prep.* 1. (*Dr Collier.*) Tincture of castor, 1 fl. dr.; sulphuric ether, 10 drops; peppermint water, 11 fl. dr.; mix. In hysteria, and that species of irregular muscular action dependent on debility.

2. (*Dr Gregory.*) Fetid spirit of ammonia, ½ to 1 fl. dr.; camphor mixture, 10 fl. dr.; syrup of saffron, 1 fl. dr. In cases complicated with low spirits, debility, &c.

3. (*A. T. Thomson.*) Musk mixture, 14 fl. dr.; liquor of ammonia, 16 drops; tincture of castor, 1 fl. dr.; syrup of poppies, ½ fl. dr.; mix. Three or four times daily, in hysteria and convulsive affections, after the bowels have been well cleared by some aperient.

4. (*A. T. Thomson.*) Oil of aniseed, 10 drops; magnesia, 20 gr.; tincture of senna, 2 fl. dr.; peppermint water, 10 fl. dr.; mix. In flatulence and spasms of the stomach.

Draught, Ape″rient. *Syn.* Haustus aperiens, L. *Prep.* 1. (*Paris.*) Infusion of senna, 1 fl. oz.; tincture of senna, tincture of jalap, and syrup of senna, of each, 1 fl. dr.; tartrate of potassa, 1 dr.; mix.

2. (*Ryan.*) Epsom salts, 4 dr.; tincture of senna, 1½ fl. dr.; syrup of ginger, 1 fl. dr.; spirit of sal-volatile, 20 drops; infusion of senna, 1½ fl. oz.

3. (*Thomson.*) Tartrate of potassa, 3 dr.; tincture of senna and syrup of saffron, of each, 1 dr.; infusion of senna, 1½ oz. The above are good aperients, and in their composition and action resemble the ordinary 'black draught.'

4 (Effervescing a. d.)—*a.* (*Dr Barker.*)

Bisulphate of potassa, 73 gr.; carbonate of soda, 72 gr.; water, q. s.; dissolve the two in separate glasses, mix the solutions, and drink whilst effervescing, in the same way as soda water.

b. (*W. Cooley.*) Bicarbonate of soda, 1 dr.; potassio-tartrate of soda, 2 dr.; dissolve in about 1-3rd of a glassful of cold water; and pour it on another like quantity of water, holding in solution tartaric acid, 40 gr., and syrup of orange peel, 1½ fl. dr.; and drink it instantly.

c. (*Paris.*) Potassio-tartrate of soda, 2 dr.; bicarbonate of soda, 40 gr.; dissolve, and add lemon juice, 1 or 2 tablespoonfuls.

d. (*Young.*) Cream of tartar, 3 dr.; carbonate of soda, 2½ dr.; throw them into a soda-water bottle three parts filled with cold water, cork immediately, and wire down the cork. The last three are examples of FACTITIOUS EFFERVESCING SEIDLITZ WATER, and are good saline aperients. The method of taking them may be varied by mixing the dry ingredients (in fine powder) on a piece of paper, and throwing the mixture suddenly into a tumbler 2-3rds filled with water, and drinking the liquid while effervescing. See CATHARTIC D. (*below*).

Draught, Ap'petite. See DRAUGHT, DINNER.

Draught, Aromati'c. *Syn.* AROMATIC ANTACID, DRAUGHT; HAUSTUS AROMATICUS, L. *Prep.* 1. Aromatic confection, 1 dr.; spirit of sal-volatile, ½ dr.; syrup of saffron, 2 dr.; pimento water, 9 fl. dr. Excellent in dyspepsia, with acidity, and in diarrhœa, preceded by an aperient.

Draught, Astrin''gent. *Syn.* HAUSTUS ASTRINGENS, L. *Prep.* 1. Tannin, 3 gr.; rectified spirit, 1 fl. dr.; simple syrup, 2 fl. dr.; water, 6 fl. dr.

2. (*Dr Paris.*) Chalk mixture, 1½ fl. oz.; tincture of catechu, 1 fl. dr.; laudanum, 15 drops.

3. (*Thomson.*) Extract of logwood, 12 gr.; tincture of catechu, 1 fl. dr.; cinnamon water, 15 fl. dr. The above are excellent remedies in diarrhœa (preceded by a purgative), and in dysentery, &c. One may be taken after each motion.

Draught, Black. See MIXTURE.

Draught, Cathar'tic. *Syn.* HAUSTUS CATHARTICUS, L. The following are given as additions to those under APERIENT D., and other heads:—*Prep.* 1. (*Dr Thomson.*) Tartrate of potassa, 5 dr.; tincture of senna, 1 fl. dr.; infusion of senna, 14½ fl. dr.; syrup of saffron, ½ fl. dr.; mix. In acute diseases, taken early in the morning.

2. (*Thomson.*) Epsom salts and manna, of each, 2 dr.; infusion of roses, 14 fl. dr.; dilute sulphuric acid, 10 drops. In inflammatory affections, and to check vomiting in low fevers.

3. (*Thomson.*) Carbonate of magnesia, 1 dr.; powdered rhubarb, 20 gr.; peppermint water, 12 fl. dr. In dyspepsia, attended with costiveness and acidity, taken an hour before dinner.

4. (*Thomson.*) Castor oil, 5 fl. dr.; powdered gum, 20 gr.; rose water, 1 fl. oz.; compound tincture of lavender, 8 drops; syrup of poppies, 1 fl. dr. In colic and calculus. The above differ from aperient draughts simply in their greater strength.

Draught, Chalk. *Syn.* HAUSTUS CRETÆ, L. *Prep.* 1. Powdered gum, chalk, and simple syrup, of each, 1 dr.; aromatic water (as that of caraway, cinnamon, nutmeg, pimento, or peppermint), 1½ fl. oz.

2. CHALYBEATED C. D.; HAUSTUS CRETÆ ET FERRI, L. (*Paris.*) Chalk mixture, 7 fl. dr.; compound mixture of iron, 3 fl. dr.; sesquicarbonate of ammonia, 5 or 6 gr. In diarrhœa, particularly in that arising from debility and anæmia.

3. (C. D. WITH RHUBARB; HAUSTUS CRETÆ CUM RHEO, L.) *a.* Chalk mixture (see *above*), 1½ fl. oz.; powdered rhubarb, 12 gr.

b. (Lond. Hosp.) Powder of chalk with opium, 12 gr.; rhubarb, 15 gr.; syrup of saffron and compound tincture of cardamoms, of each, 1 fl. dr.; caraway water, 10 fl. dr. In heartburn, dyspepsia, and certain forms of diarrhœa.

Draught, Chlorine. *Syn.* HAUSTUS CHLORINII, L. *Prep.* (*Copland.*) Chlorine water, ½ fl. dr.; water, 1½ fl. oz.; mix, and add of syrup of poppies, ½ fl. dr. One every 6 hours; in the worst form of typhus fever, and other putrid diseases, &c.

Draught, Cit'rate of Ammo''nia. *Syn.* HAUSTUS AMMONIÆ CITRATIS, H. A. SESQUICARBONATIS EFFERVESCENS, L. *Prep.* (Guy's Hosp.) Sesquicarbonate of ammonia, 20 gr.; water, 1 fl. oz.; dissolve and add of lemon juice, ½ fl. oz.; An agreeable, cooling, saline draught in febrile cases.

Draught, Citrate of Potas'sa. *Syn.* HAUSTUS POTASSÆ CITRATIS, L. *Prep.* From carbonate of potassa, 24 gr. (or bicarbonate, 29 gr.); water, 1 fl. oz.; dissolve and add of lemon juice, 5 fl. dr. As the last. 20 gr. of citric acid may be used instead of the lemon juice.

Draught, Colchicum. See DRAUGHT, ANTIARTHRITIC.

Draught, Cough. See MIXTURE.

Draught, Diaphoret'ic. *Syn.* HAUSTUS DIAPHORETICUS, L. *Prep.* 1. (*Collier.*) Infusion of serpentery, 1½ fl. oz.; tincture of serpentery, 1 fl. dr. Tonic and diaphoretic.

2. (*Thomson.*) Sesquicarbonate of potassa, 20 gr.; fresh lemon juice, 4 fl. dr.; tartrate of antimony, ⅙ gr.; water, 11 fl. dr.; syrup of poppies, 1 fl. dr. Antifebrile and diaphoretic.

3. (*Thomson.*) Liquor of acetate of ammonia, 6 fl. dr.; camphor mixture, 10 fl. dr.; nitrate of potassa, 10 gr.; syrup of tolu, ½ fl. oz. Anodyne and diaphoretic. All the above are used in inflammatory affections.

Draught, Din'ner. *Syn.* APPETITE DRAUGHT; HAUSTUS DICTUS ANTE CIBUM. *Prep.* 1. Tinctures of cascarilla, hops, and rhubarb, of each, 1 fl. dr.; spirit of sal-volatile, ½ fl. dr.; tincture of capsicum, 20 drops; syrup of orange peel, 2 dr.; water, 1½ fl. oz.

2. Compound tincture of gentian, ½ fl. oz.; sal-volatile, ½ a teaspoonful; cinnamon water, 1 fl. oz.; compound tincture of cardamoms, 1 teaspoonful. Either of the above to be taken an hour before a meal.

Draught, Diuret'ic. *Syn.* HAUSTUS DIURETICUS, L. *Prep.* 1. (*Collier.*) Tincture of jalap, 2 fl. dr.; vinegar of squills, 1 fl. dr.; peppermint water, 10 fl. dr.; mix.

2. (*Copland.*) Acetate of potassa, ½ dr.; infusion of quassia and cinnamon water, of each, 6 fl. dr.; vinegar of squills and sweet spirits of nitre, of each, ½ fl. dr.

3. (*Thomson.*) Nitre, 8 gr.; tincture of digitalis, 16 drops; infusion of roses, 13 fl. dr.; syrup of roses, 1 fl. dr.

4. (*Turner.*) Nitre and powdered gum, of each, 15 gr.; almond mixture, 1½ fl. oz. The above are used as diuretics in dropsy; the last, also in scurvy, and in the incontinence of urine of children.

Draught, Donovan's. *Syn.* DRAUGHT OF HYDRIODATE OF ARSENIC AND MERCURY; HAUSTUS HYDRIODATIS ARSENICI ET HYDRARGYRI, L. *Prep.* (*Donovan.*) Liquor of hydriodate of arsenic and mercury (*Donovan's*), 2 fl. dr.; distilled water, 3½ fl. oz.; syrup of ginger, ½ fl. oz.; mix for 4 draughts. One, night and morning; in lepra, lupus, psoriasis, and some other obstinate cutaneous affections. It must not be allowed to touch anything metallic.

1. (*Copland.*) Ipecacuanha, 30 gr.; sesquicarbonate of ammonia, 20 gr.; tincture of capsicum, 30 drops; oil of chamomile, 10 drops; mint water, 2 fl. oz. As a stimulant emetic in cases of poisoning by laudanum or other narcotics.

2. (*Dr Pickford.*) Sulphate of zinc, 20 gr.; sulphate of magnesia, 4 dr.; water, 1¾ oz. When it is also desired to act rapidly on the bowels.

3. (*Rodier.*) Sulphate of copper, 10 gr.; water, 2 fl. oz. In poisoning by laudanum.

4. (*Sprague.*) Ipecacuanha, 30 gr.; sequicarbonate of ammonia, 20 gr.; tincture of capsicum, 1 fl. dr.; peppermint water, 3 fl. oz. In poisoning by narcotics.

5. (*A. T. Thomson.*) Ipecacuanha, 20 gr.; ipecacuanha wine, 2 fl. dr.; water, 10 fl. dr. For unloading the stomach in ordinary cases.

6. (*Trousseau.*) Ipecacuanha, 8 gr.; syrup of ipecacuanha, 1 fl. oz.; water, q. s. for 4 draughts. One every 10 minutes, until vomiting occurs.

Draught, E'ther. *Syn.* HAUSTUS ÆTHEREUS, L. *Prep.* (*Neligan.*) Sulphuric ether, 1 fl. dr.; spermaceti, 3 gr.; rub together (expertly), and add of peppermint water, 10 fl. dr. An excellent stimulant and antispasmodic, febrile symptoms being absent.

Draught, Expec'torant. *Syn.* HAUSTUS EXPECTORANS, L. *Prep.* 1. (*Collier.*) Mixtures of ammoniacum and almonds, of each, 6 fl. dr.; tincture of squills, 12 drops. In hoarseness, chronic coughs, &c.

Draught, Hen'bane. *Syn.* HAUSTUS HYOSCYAMI, L. *Prep.* 1. Tincture of henbane, 30 to 60 drops; syrup of saffron, 1 fl. dr.; water, 10 fl. dr. Anodyne and soporific. Used to allay nervous excitement and induce sleep when laudanum is inadmissible.

2. HENBANE AND SQUILLS D.; HAUSTUS HYOSCYAMI CUM SCILLÂ, L. (*Dr Bree.*) Extract of henbane, 3 gr.; tincture of squills, 10 drops; dilute nitric acid, 6 drops; water, 1½ fl. oz. Anodyne and expectorant; in asthmas, chronic coughs, &c.

Draught, Hydrocyan'ic. *Syn.* HAUSTUS HYDROCYANICUS, L. *Prep.* 1. (*Donovan.*) Cyanide of potassium, 1 gr.; syrup of lemons, ½ fl. oz.; distilled water, 7½ fl. oz. For 8 draughts. One for a dose.

2. (*Dr S. Dickson.*) Medicinal hydrocyanic acid (L.), 15 drops; liquor of ammonia, 20 drops; syrup of orange flowers (or simple syrup), 3 fl. dr.; water, 8½ fl. oz.; mix, and divide into 6 draughts. One, 2, or 3 times a day; in gastrodynia and all those nameless nervous and hysterical affections arising from excessive irritability, mental anxiety, &c. In a case that came under our notice, in which life was an absolute burden to the patient, relief was afforded by the first draught, and 4 or 5 effected a comparative cure, although almost every other remedy had been tried in vain (*Cooley*).

Draught, Laennec's. *Syn.* LAENNEC'S CONTRA-STIMULANT DRAUGHT; HAUSTUS CONTRA-STIMULANS, L. *Prep.* From tartar emetic, 2 gr.; syrup of poppies, 2 fl. dr.; orange-flower water, 1½ fl. oz. Every 2 hours in pneumonia, &c.

Draught, Lax'ative. *Syn.* HAUSTUS LAXANS, L. *Prep.* 1. See DRAUGHTS, APERIENT.

2. (*Dr Copland.*) Infusion of senna and compound infusion of gentian, of each, 6 fl. dr.; sulphate of potassa, 20 to 30 gr.; extract of taraxacum, 30 to 40 gr.; compound tincture of cardamoms, 1½ fl. dr. Aperient, stomachic, and alterative.

Draught, Mor'phia. *Syn.* HAUSTUS MORPHIÆ, L. *Prep.* (*Brera.*) Morphia, ¼ gr.; syrup of poppies, 1 fl. dr.; water, 11 fl. dr. 2 or 3 drops of acetic acid may be advantageously added. At bedtime, as a soporific.

Draught, Narcot'ic. *Syn.* HAUSTUS NARCOTICUS, H. OPIATUS, L. *Prep.* 1. (St B. Hosp.) Laudanum, 12 to 20 drops; syrup of red poppies, 1 fl. dr.; pimento water, 3 fl. dr.; water, 1 fl. oz. To induce sleep in slight cases, when fever is absent.

2. (*A. T. Thomson.*) Camphor mixture, 1½ fl. oz.; laudanum 35 drops; sulphuric ether and syrup of saffron, of each, 1 fl. dr. In intermittent headache.

3. (*Thomson.*) Carbonate of ammonia, 15 gr.; fresh lemon juice, ½ fl. oz.; water, 1 fl. oz.; spirit of nutmeg, 1 fl. dr.; syrup of orange peel, ½ fl. dr.; tincture of hemlock, 10 drops. In diseases of increased irritability.

4. (*Thomson.*) Carbonate of potassa, 20 gr.; fresh lemon juice, ½ fl. oz.; peppermint water, 1 fl. oz.; laudanum, 25 drops; syrup of tolu, ½ fl. dr. To procure sleep in the majority of diseases. (See *above.*)

Draught, Nux Vom'ica. *Syn.* HAUSTUS NUCIS VOMICÆ, L. *Prep.* (*Dr Joy.*) Nux vomica (in fine powder), 3 gr.; powdered gum, 2 dr.; compound tincture of cardamoms, 1 fl. dr.; cinnamon water, 10 fl. dr. Diuretic, narcotic, stimulant, and tonic; in paralysis, impotence, debility, &c., unaccompanied by inflammation of the nervous centres. See STRYCHNINE.

Draught, Refri''gerant. *Syn.* HAUSTUS REFRIGERANS, L. *Prep.* 1. Carbonate of potassa, 20 gr.; syrup of orange peel, 1 fl. dr.; spirit of nutmeg, ½ fl. dr.; water, 1½ fl. oz.

2. (*Thomson.*) Nitre, 12 gr.; almond mixture, 1½ fl. oz.; syrup of tolu, 1 fl. oz.

3. (*Collier.*) Carbonate of potassa, 20 gr.; antimonial wine, 20 drops; syrup of orange peel, 1 fl. dr.; tincture of orange peel, ½ fl. dr.; water, 1½ fl. oz.; mix, and add a large tablespoonful of lemon juice. In inflammatory diseases, &c.

Draught, Saline. SEE DRAUGHT, EFFERVESCING, &c.

Draught, Stomach'ic. See DRAUGHT, DINNER, &c.

Draught, Ton'ic. *Syn.* STRENGTHENING DRAUGHT; HAUSTUS TONICUS, L. *Prep.* 1. (*Collier.*) Disulphate of quinine, 2 gr.; tincture of orange peel, 1 fl. dr.; diluted sulphuric acid, 5 drops; laudanum, 10 drops; infusion of cascarilla, 1½ fl. oz. In pyrosis, &c., 1 hour before dinner.

2. (*A. T. Thomson.*) Infusion of yellow bark, 1½ fl. oz.; compound tincture of cinchona, 1 fl. dr.; powdered cinchona, 40 gr.; syrup of orange peel, 1 fl. dr. In intermittents and acute rheumatisms.

3. (*Thomson.*) Infusion of cascarilla, 1½ fl. oz,; tincture of cascarilla and ginger, of each, 1 fl. dr. In dyspepsia arising from intemperance.

4. (*Walton.*) Infusion of cascarilla, 9 fl. dr.; tinctures of rhubarb and ginger, of each, 1 fl. dr.; syrup of saffron, ½ fl. dr.; ammonio-citrate of iron, 6 gr.; tincture of capsicum, 5 drops. In anæmia and debility accompanied by paleness and relaxation.

Draught, Ver'mifuge. *Syn.* HAUSTUS VERMIFUGUS, H. ANTHELMINTHICUS, L. *Prep.* (*M. Levacher.*) Castor oil, 4 dr.; oil of turpentine, 2 dr.; mint water, 2 fl. oz.; syrup, 1 fl. oz.; powdered gum, 2 dr.; for an emulsion. In tapeworm.

DRAW'INGS. Chalk and pencil drawings may be fixed so as not to suffer from slight abrasion, by washing them with skimmed milk, or with water holding in solution a little isinglass or gum. When the first is used, great care must be taken to deprive it of the whole of the cream, as the latter substance would cause the drawing to look streaky. An easy way of applying these fluids is to pour them into a shallow vessel, and to lay the drawing flat upon the surface of the liquid; after which it should be gently removed and placed on white blotting-paper, in an inclined position, to drain and dry.

Various dilute gums and varnishes are sold under the name of 'Fixatif,' in bottles furnished with a simple spray apparatus, which is a very convenient and safe way of applying them, especially to chalk and charcoal drawings.

DREESCHE'S IRON—LIQUOR FERRI ALBUMINAT. Take 30 grms. of dried egg-albumen (or 5 times that quantity of fresh albumen, which makes a clearer preparation) and place it in a mortar capable of holding a litre; rub the dried albumen to fine powder and add all at once 100 grms. of perchloride of iron dissolved in 100 grms. of water; stir constantly, as the albumen has a tendency to clot; and when the mixture is perfectly homogeneous add 60 c.c. of seminormal soda solution; stir well so as to complete the solution, and make it up to 500 grms. in weight. Now mix separately 330 grms. of cinnamon water and 170 grms. of 90% alcohol, and add this mixture to the alkaline fluid. The advantages of this preparation are its powerful hæmatinic properties; it is tasteless and non-astringent.

DRENCHES. *Syn.* DRINKS. In *veterinary practice*, these terms are applied to liquid medicines or mixtures which are administered to horses and neat cattle, and chiefly to the latter. A drench for a HORSE should not be less than ½ pint, nor more than a quart; about a pint is, perhaps, the best quantity; that for a COW or OX should measure about a quart, and not more than about 5 half pints. See VETERINARY MEDICINE.

DRES'SING. In the *industrial arts*, a preparation of gum, starch, size, &c., employed in stiffening or 'finishing off' textile fabrics and paper. In *surgery*, the term is appropriated to any application to a wound or sore, made by means of lint, linen, or leather. SIMPLE DRESSING is simple cerate or spermaceti cerate. Among *cooks*, the stuffing of fowls, pork, veal, &c., is commonly called 'dressing.'

DRIERS. Driers are substances employed to facilitate the drying of paints. The driers most commonly employed are sugar of lead, litharge, and white copperas. Either of these, when well ground and mixed in small proportion with paints, very materially hastens their drying. Indeed, some colours will not dry without them. Red lead is also well adapted for a drying agent, and in cases where its colour does not preclude it, is much used. The best drier is sugar of lead. Its cost, however, is somewhat higher than that of the other driers. It is important to bear in mind that in the finishing coats of delicate colours driers are not generally had recourse to, as they have a slight tendency to injure the colour. A drying property may be imparted to linseed oil by boiling it with drying substances; it then becomes a very useful vehicle for paints. See OILS, DRYING.

DRIFFIELD OILS. For the prevention of gangrene and for healing incised and other wounds bruises, sprains, swellings, and external inflammations. A dusky brownish-green clear oil, consisting of (1) olive oil, digested with wormwood, savin, and arnica, and afterwards perfumed with a mixture of oils of rosemary, thyme, and juniper, 1 pint (474 grms.) (*Hager*).

(2) Barbadoes tar, 1 oz.; linseed oil, 1 lb.; oil of turpentine, 3 oz.; oil of vitriol, 1 oz.

DRINK, CORDIAL. (*Dr Cherwy.*) A herbal lemonade to heal all chronic and scrofulous diseases. It contains 115 grms. water, 15 grms. spirit, 2 grms. potassium iodide, 5 grms. bitter almond water, 10 grms. sugar, and 3 grms. burnt sugar (*Hager*).

DRINKS (Summer). See BEER, GINGER, LEMONADE, SHERBET, &c.

DRIPPING, TO CLARIFY. Put the dripping into a stewpan over the fire, and let it boil, and as it does so, skim it carefully. When it boils pour it into a basin, in which you have previously put a little cold water. It must stand till cold. It is then to be taken out of the water. The dripping will now be in the form of a cake, at bottom of which will be found adhering little pieces of meat, skin, &c. These must be scraped off, and the dripping will have been purified. Another method is to mix boiling water with the dripping, to stir well, let it get cold, and then to take it out and scrape it as above.

DROP. See MEASURES.

DROPS (Confectionery). These are confections of which the principal basis is sugar. They differ from lozenges chiefly in the ingredients being

combined by the aid of heat. Occasionally they they are medicated.

Prep. Double refined sugar is reduced to powder, and passed through a hair sieve (not too fine), and afterwards through a gauze sieve, to take out the fine dust, which would destroy the beauty of the drop. It is then put into a clean pan, and moistened with any favourite aromatic, as rose or orange-flower water, added slowly, stirring it with a paddle all the time, from which the sugar will fall, as soon as it is moist enough, without sticking. The colour (if any) is next added, in the liquid state, or in very fine powder. A small, polished copper, or tinned copper pan, furnished with a lip, is now one half or three parts filled with paste and placed over the fire, or over the hole of a stove, or preferably on a sand-bath, and the mixture stirred with a little bone or glass spatula until it becomes liquid. As soon as it almost boils, it is taken from the fire, and if it is too moist, a little more powdered sugar is added, and the whole stirred, until it is of such a consistence as to run without too much extension. A tin plate, very clean and smooth, and very slightly oiled, being now ready, the pan is taken in the left hand, and a bit of bright iron, copper, or silver wire, about 4 inches long, in the right. The melted sugar is next allowed to fall regularly on the tin plate, the wire being used to remove the drop from the lip of the pan. In 2 or 3 hours afterwards the drops are taken off with the blade of a knife, and at once put into bottles or tins. On the large scale, 'confectionery drops' are moulded by a machine consisting essentially of two metal rollers, covered with hollows. A sheet of the warm and soft composition, on being passed between the rollers, is at once converted into a batch of symmetrical drops, the upper and lower halves being moulded by the corresponding hollows of the upper and lower rollers. See CANDYING, CONFECTION, ESSENCE, STAINS (Confectioner's), SUGAR PLUMS.

The following are a few of the principal confectionery drops kept in the shops:

Drops, Acid'ulated. *Syn.* ACID DROPS. *Prep.* Tartaric acid, ½ oz., dissolved in a very little water, is added to each lb. of sugar, as *above;* with essence of lemon, orange, or jargonelle pear, to flavour, as desired.

Drops, Chocolate. *Prep.* Chocolate, 1 oz., is reduced to a fine powder by scraping, and added to powdered white sugar, 1 lb.; when the mixture is made into drops, as *above*, care being taken to avoid heating it a second time.

Drops, Cof'fee. *Prep.* A clarified, concentrated infusion of coffee, 1 oz., is used for each lb. of sugar.

Drops, Fruit. These are prepared according to the general description (see *above*), the flavouring essences (volatile oils or essences of lemon, orange, citron, raspberry, jargonelle pear, &c.) not being added until the sugar is melted, to avoid, as much as possible loss by evaporation. The colouring matter may be any of the transparent 'stains' usually employed for cakes, jellies, and confectionery. In this way are made the majority of the first-class fruit drops and bonbons of the sugar-bakers. In some cases the plan is varied by adding the clarified concentrated juice, or jelly of the fruit to the sugar. One variety of raspberry and currant (red and black) drops are made in this way.

Drops, Ginger. *Prep.* From essence or tincture of ginger, as *above.* An inferior kind is made in the way described under CANDY, GINGER.

Drops, Jargonelle. Fruit drops flavoured with essence of jargonelle pear (SOLUTION OF ACETATE OF AMYLE).

Drops, Lem'on. Acidulated drops flavoured with essence of lemon. They are usually stained with an infusion of turmeric. (See *above.*)

Drops, Pep'permint. From the whitest refined sugar, flavoured with English oil of peppermint or its spirituous solution (essence of peppermint), or with peppermint water.

Drops, Rasp'berry. See DROPS, FRUIT (*above*).

DROPS (Med'icated). *Syn.* GUTTÆ, L. This term is commonly applied to compound medicines that are only taken in small doses. At the present time they are almost exclusively confined to empirical and domestic medicine. The plan of directing liquids to be measured by dropping is objectionable, because the drops of different fluids vary in size, and are also further influenced by the size of the bottle and the shape of its neck, as well as the quantity of liquid it is poured from. See ESSENCE and *below.*

Drops, Acoustic. *Syn.* ACOUSTIC BALSAM; GUTTÆ ACOUSTICÆ, BALSAMUM ACOUSTICUM, L. *Prep.* 1. Oil of almonds, 1 oz.; laudanum and oil of turpentine, of each, 1 dr.; mix. For hardening wax, and to allay pain.

2. Tinctures of benzoin, castor, and opium, of each, 1 fl. oz.; essential oil of assafœtida, 5 drops. As the last, and in deafness arising from debility of the organism.

3. (*Baumé's.*) Tinctures of ambergris, assafœtida, castor, and opium, of each, 1 oz.; terebinthinated balsam of sulphur and oil of rue, of each, 15 drops. In atonic deafness.

4. (*Bouchardat.*) Compound spirit of balm, 2½ dr.; oil of almonds, 5 dr.; ox-gall, 10 dr.; creosote, 10 to 20 drops. In cases complicated with hardened wax, fœtid discharges, &c.

5. (*Dr Hugh Smith.*) Ox-gall, 3 dr.; balsam of Peru, 1 dr. In fœtid ulcerations of the ear. One or 2 drops of the above are poured into the ear; or a piece of cotton wool moistened therewith is introduced instead. The last is the safest plan.

6. Glycerin, either alone or diluted with water. In deficiency of the natural secretions of the ear; used in sufficient quantity to moisten the first passages. See DEAFNESS, GLYCERIN.

Drops, A'gue. See SOLUTION (Arsenite of Potassa).

Drops, An'odyne. *Syn.* GUTTÆ ANODYNÆ, L. The solutions of acetate and hydrochlorate of morphia are commonly vended in the shops under this name.

Drops, Ant'acid. *Syn.* GUTTÆ ANTACIDÆ, L. *Prep.* (U. C. Hosp.) Liquor of potassa, 3 fl. oz.; powdered myrrh, 1 oz.; triturate together until thoroughly incorporated, add of liquor of ammonia, 1 fl. oz., mix well, place the mixture in a stoppered bottle, and the next day decant the clear portion. Antacid, tonic, and stomachic.—*Dose,* 10 to 20 drops, or more, in water.

Drops, Antihyster'ic. *Syn.* GUTTÆ ANTIHYSTERICÆ, L. *Prep.* Cyanide of potassium, 2 gr.; rectified spirit, 5 fl. dr.; syrup of orange flowers, 3 fl. dr.—*Dose*, 10 drops to ½ teaspoonful when the attack is expected, and repeated occasionally as required; in hysterical affections, gastrodynia, &c.

Drops, Antiscorbu'tic. *Syn.* GUTTÆ ANTISCORBUTICÆ, L. *Prep.* 1. Expressed juice of water-cress, 2 fl. oz.; salt of tartar, 1 oz.; agitate together occasionally for a few hours, and in 2 or 3 days decant.—*Dose*, 12 or 15 drops to a teaspoonful twice a day in a cupful of new milk.

2. Citrate of potassa, 4 dr.; ammonio-citrate of iron, 2 dr.; water, 10 fl. dr.—*Dose.* As the last, in water.

3. (GREEN'S ANTISCORBUTIC DROPS.) Merely a disguised solution of corrosive sublimate. Most of the other 'antiscorbutic' and 'anti-venereal dreps' advertised by quacks have a like composition.

Drops, Antiscrof'ulous. *Syn.* GUTTÆ ANTISCROFULOSÆ, L. *Prep.* 1. Iodine, 10 gr.; iodide of potassium, 1 dr.; water, 1 fl. oz.

2. (*Augustin.*) Chlorides of iron and barium, of each, ½ dr.; distilled water, 1 fl. oz.—*Dose*, 10 to 30 drops 2 or 3 times a day.

Drops, Antispasmod'ic. *Syn.* GUTTÆ ANTISPASMODICÆ, L. *Prep.* Tinctures of castor, valerian, and assafœtida, of each, 2 dr.; tincture of capsicum and balsam of Peru, of each, 1 dr.; camphor, 20 gr.; acetate of morphia, 3 gr.—*Dose*, 10 to 20 drops, as required.

Drops, Bateman's. See DROPS, PECTORAL.

Drops, Battley's. See LIQUOR OPII SEDATIVUS.

Drops, Bitter. *Syn.* GUTTÆ AMARÆ, L.; GOUTTES AMÈRES, Fr. *Prep.* From nux vomica (rasped), 1 lb.; liquor of potassa, ½ fl. oz.; bistre, 1 dr.; compound spirit of wormwood, 32 fl. oz.; digest 10 days, express the tincture, and filter. A most unscientific preparation; said to be tonic and stomachic.—*Dose*, 1 to 8 drops in water or any bitter infusion. In large doses it is poisonous.

Drop, Black. *Syn.* ARMSTRONG'S BLACK DROP, LANCASTER'S B. D., QUAKER'S B. D., TOUSTALL'S B. D., BRAITHWAITE'S GENUINE B. D.; GUTTA NIGRA, L. This celebrated preparation was originally prepared nearly a century and a half ago by Edward Toustall, a medical practitioner in the county of Durham, and one of the Society of Friends. The formula passing into the possession of a relative of his (John Walton, of Shildon), was found among his brother's papers, and, by the permission of Thomas Richardson, of Bishop's Wearmouth, one of his executors, was handed to Dr Armstrong, who subsequently published it in his work on typhus fever.

Prep. 1. (Original formula.) Opium (sliced), ½ lb.; good verjuice, 3 pints; nutmegs, 1½ oz.; saffron, ½ oz.; boil them to a proper thickness; then add, of sugar, ¼ lb., and yeast, 2 teaspoonfuls. Set the whole in a warm place, near the fire, for 6 or 8 weeks, then place it in the open air until it becomes of the consistence of a syrup; lastly decant, filter, and bottle it up, adding a little sugar to each bottle. To yield 2 pints of strained liquor.

2. (ACETUM OPII, L.—U.S.) Opium, 8 oz.; nutmeg, 1½ oz. (both in coarse powder); saffron, ½ oz.; distilled vinegar, 24 fl. oz.; digest on a sand-bath with a gentle heat for 48 hours, and strain; digest the residuum with an equal quantity of distilled vinegar for 24 hours; then put the whole into a percolator, and return the filtered liquid as it passes until it runs clear; afterwards pour on the material fresh distilled vinegar until 48 fl. oz. of filtered liquor shall be obtained; in this dissolve sugar 12 oz., and gently evaporate the whole to 52 fl. oz.

3. (Wholesale.) Opium, 10 oz., and distilled vinegar, 1 quart, are digested together for about a fortnight, and after sufficient repose the clear portion is decanted. This is the form commonly adopted by the wholesale trade in England.—*Dose*, 5 to 10 drops. It is usually considered to be of fully 4 times the strength of laudanum.

Drops, Carmin'ative. *Syn.* GUTTÆ CARMINATIVÆ, L. *Prep.* (*Radius.*) Oil of mace, 1 dr.; nitric ether, 3 dr.—*Dose*, 6 to 10 drops on sugar; in flatulent colic, &c.

Drops, Cham'omile. See ESSENCE.

Drops, Cholera—Choleratropfen. (*A. Bastler*, Vienna.) Oils of anise, cajeput, and juniper berries, of each, 20 parts; spirit of ether, 60 parts; tincture of cinnamon, 120 parts; Haller's acid elixir, 5 parts.—*Dose*, 30 to 50 drops (*Wittstein*).

Drops, Dalby's. See PATENT MEDICINES (Dalby's Carminative).

Drops, Durande's. *Syn.* GUTTÆ ÆTHERIS TEREBINTHINATÆ, L. *Prep.* (*M. Durande.*) Rectified sulphuric acid, 3 parts; oil of turpentine, 1 part.—*Dose*, 20 to 30 drops, or more; in the passing of gall-stones.

Drops, Dutch. *Syn.* HAERLEM DROPS, TURPENTINE DROPS; BALSAMUM TEREBINTHINÆ, L. The genuine or imported 'Dutch Drops' is the residuum of the rectification of oil of turpentine. It is also prepared by distilling resin and collecting the product in different portions. At first a white, then a yellow, and lastly a red oil, comes over. The last is the balsam. The article commonly sold under the name in this country is prepared by one or other of the following formulæ:

1. Oil of turpentine, tincture of guaiacum, and sweet spirit of nitre, of each, 1 oz.; oils of amber and cloves, of each, 15 drops.

2. Balsam of sulphur, 1 part; oil of turpentine, 5 parts. This last is the form most generally employed. They are all regarded by those who use them as detergent, diuretic, stimulant, and vulnerary.

3. Linseed oil, 1 quart; resin, 2 lbs.; sulphur, 1 lb. Boil together over a slow fire; when combined, remove from the fire and add 1 pint oil of turpentine and 50 drops liq. ammonia; stir and bottle.

Drops, Female. *Syn.* EMMENAGOGUE DROPS; GUTTÆ EMMENAGOGÆ, L. *Prep.* (*Brande.*) Compound tincture of aloes and tincture of valerian, of each, 2 fl. oz.; tincture of sesquichloride of iron, 1 fl. oz.—*Dose.* A teaspoonful in water or chamomile tea; in obstructed menstruation, &c.

Drops, Fit. *Syn.* SOOT DROPS; TINCTURA FULIGINIS, GUTTÆ F., L. *Prep.* From woodsoot, 2 oz.; sal-ammoniac, 1 oz.; salt of tartar,

½ lb.; soft water, 4 lbs.; digest a week and filter. Reputed antispasmodic, and also useful in scurvy and certain skin diseases.—*Dose.* A teaspoonful or more, occasionally, in water.

Drops, Golden. DE LA MOTTE'S G. D.; BESTUCHEFF'S NERVOUS TINCTURE; GUTTÆ AUREÆ, L.; ELIXIR D'OR, GOUTTES D'OR DU GÉNÉRAL LAMOTTE, Fr. *Prep.* 1. (Original.) Chloride of iron (obtained by distilling iron pyrites with twice its weight of corrosive sublimate), 3 oz.; alcohol, 7 oz.; expose the mixture in a closely stoppered bottle to the rays of the sun until it becomes decolorised.

2. Chloride of iron, 1 part; alcohol and ether, of each, 3 parts. These drops have the remarkable property of losing their yellow colour in the sun, and recovering it in the shade. They are taken in gout, hypochondriasis, and nervous complaints, in doses of from 10 to 60 drops.

Drops, Hooping-Cough. *Syn.* GUTTÆ ANTIPERTUSSICÆ, L. *Prep.* 1. (*Dr Graves.*) Tincture of assafœtida and compound tincture of camphor, of each, ½ fl. oz.; compound tincture of bark, 5 fl. oz.—*Dose.* A teaspoonful, 2 or 3 times a day.

2. (*Potestates Succini.*) Oil of amber, 1 oz.; carbonate (not sesquicarb.) of ammonia, ½ oz.; strongest rectified spirit (alcohol), ½ pint; digest 3 or 4 days, and decant the clear portion.—*Dose,* 10 drops to 1 dr., applied as a friction.

Drops, Infantile. Several anodyne, carminative, and absorbent preparations, which pass by this name, will be found under MIXTURES, &c.

Drops, Jes′uits. *Syn.* ELIXIR ANTIVENEREUM, L. *Prep.* 1. Gum-guaiacum, 7 oz.; balsam of Peru, 4 dr.; root of sarsaparilla, 5 oz.; rectified spirit of wine, 1 quart; digest for 14 days.

2. (*Quincy.*) Copaiba, 1 oz.; gum-guaiacum, 2 dr.; oil of sassafras, 1 dr.; salt of tartar, ½ dr.; rectified spirit, 5 fl. oz.; digest a week.

3. (*Walker's.*) Copaiba, 6 oz.; gum-guaiacum, 1 oz.; chio turpentine and salt of tartar, of each, ½ oz.; cochineal, 1 dr.; rectified spirit, 1 quart; digest a week. See COMP. TINCTURE OF BENZOIN.

Drops, Kœchlin's. *Prep.* (*Augustin.*) Solution of ammonio-chloride of copper and mercury, 1 fl. dr.; water, 10 fl. dr. In obstinate venereal affections, scrofula, &c.—*Dose.* A teaspoonful after each meal.

Drops, Lav′ender. *Syn.* RED DROPS; GUTTÆ LAVENDULÆ, L. The same as compound tincture of lavender.

Drops, Life. *Syn.* SALMON'S DROPS OF LIFE; GUTTÆ VITÆ, L. *Prep.* Tincture of castor, 8 fl. oz.; antimonial wine and water, of each, 1 lb.; opium, 3 oz.; saffron, ½ oz.; cochineal, camphor, and nutmegs, of each, 2 dr.; digest for 10 days and filter. Anodyne and diaphoretic.—*Dose,* 20 to 60 drops.

Drops, Mercu′′rial. *Syn.* GUTTÆ HYDRARGYRI BICHLORIDI, L. *Prep.* 1. Bichloride of mercury, 2 gr.; hydrochloric acid, 3 drops; rectified spirit and distilled water, of each, ½ fl. oz.—*Dose,* 12 to 20 drops.

2. Bichloride of mercury, 2 gr.; sal-ammoniac, 3 gr.; compound decoction of sarsaparilla, 2 fl. oz. —*Dose.* A teaspoonful.

3. (*Sir A. Cooper.*) Corrosive sublimate, 1 gr.; dilute hydrochloric acid ½ dr.; dissolve, and add tincture of bark, 2 fl. oz.—*Dose.* As the last. They are all taken 2 or 3 times daily, as alteratives in scrofula, syphilis, cancer, &c. It should not be measured in a metal spoon.

Drops, Norris's. An aqueous solution of tartar emetic, mixed with spirit of wine, and coloured.

Drops, Odontal′gic. *Syn.* TOOTHACHE DROPS; GUTTÆ ODONTALGICÆ, L. *Prep.* 1. (*Dr Blake.*) Alum (in fine powder), 1 dr.; sweet spirit of nitre, 7 fl. dr.; agitate together occasionally for an hour.

2. (*Dr Copland.*) Powdered opium and camphor, of each, 10 gr.; oils of cloves and cajeput, of each, 1 dr.; highly rectified spirit and sulphuric ether, of each, ½ fl. oz.

3. (*Cottereau.*) A saturated ethereal solution of camphor, to which a few drops of liquor of ammonia is added.

4. (*Dr R. E. Griffith.*) Wine of opium, Hoffman's anodyne, and oil of peppermint, equal parts. Used as a friction on the cheek or gum, as well as applied to the teeth.

5. (*Perry's.*) A concentrated ethereal tincture of camphor and pellitory.

6. (*Righini.*) Creosote, 6 dr.; rectified spirit, 4 dr.; tincture of cochineal, 2 dr.; oil of peppermint, ½ dr.

7. Camphor, 2 dr.; rectified spirit, 1 oz.

Obs. The above are applied to the tooth with a camel-hair pencil, or a little wad of lint or cotton wool is moistened with them, and placed in or against the tooth.

Drops, Pectoral. *Syn.* BATEMAN'S P. D.; GUTTÆ PECTORALES, L. *Prep.* 1. Paregoric, 10 fl. oz.; tincture of castor, 4 fl. oz.; laudanum, 1 fl oz.; tincture of saffron or of cochineal, ½ fl. oz.; oil of aniseed, 15 drops.

2. Castor, 1 oz.; oil of aniseed, 1 dr.; camphor, 5 dr.; cochineal, 1½ dr.; opium, ¾ oz.; treacle, 1 lb.; proof spirit, 1 gall.; digest for a week.

3. (Phil. Coll. of Pharm.) Camphor, catechu, powdered opium, and red sanders wood, of each, 2 oz.; oil of aniseed, 4 fl. dr.; proof spirit, 4 old wine-gallons; digest 10 days, and filter.—*Dose.* A teaspoonful, or more, in coughs, colds, hoarse, ness, &c., assisted by an aperient.

Drops, Rheumat′ic. *Syn.* GUTTÆ RHEUMATICÆ, L. *Prep.* 1. Iodide of potassium, 1 dr.; tincture of guaiacum, 2 fl. oz.; dissolve.—*Dose,* 20 to 30 drops. In both chronic and occasional rheumatism, assisted with the copious use of lemon juice.

2. (*Lampadius.*) Bisulphuret of carbon and ether, of each, 2 fl. dr.—*Dose,* 6 to 12 drops, on sugar, or in milk.

3. (*Wutzer.*) Bisulphuret of carbon, 1 fl. dr.; alcohol, 2 fl. dr.—*Dose.* As No. 2. The last two are sudorific, alterative, resolvent, and emmenagogue, and, besides rheumatism, have been used with advantage in amenorrhœa, in some cutaneous affections, in glandular swellings, &c.

Drops, Rosseau's. See WINE OF OPIUM (by Fermentation.)

Drops, Seda′tive. *Syn.* GUTTÆ SEDATIVÆ, L. The solutions of acetate and hydrochlorate of morphia, black drop, Rosseau's drop, and Batley's liquor opii sedativus, are frequently sold

under this name by the druggists. The anti-hysteric drops (*antè*) is also an excellent sedative.

Drops, Spilbury's. *Prep.* 1. (*Dr Paris.*) From bichloride of mercury, gentian root, and dried orange peel, of each, 2 dr.; precipitated sulphuret of antimony and red sanders wood, of each, 1 dr.; proof spirit, 16 fl. oz.; digest 10 days and strain.

2. Levigated crocus metallorum ('crocus of antimony'), 6 dr.; corrosive sublimate, 45 gr.; red sanders, ½ dr.; gentian root and dried orange peel, of each, 2 dr.; brandy (or equal parts of rect. sp. and water), 16 fl. oz.; digest as before. —*Dose*, 5 to 30 drops; as an antiscorbutic, &c.

Drops, Steel. See TINCTURE OF SESQUICHLORIDE OF IRON.

Drops, Ton'ic. *Prep.* (*Collier.*) Elixir of vitriol, 2 fl. dr.; tincture of calumba, 6 fl. dr. A teaspoonful 3 times daily, in a wine-glassful of cold water.

Drops, Torrington's. See TINCTURE OF BENZOIN (Comp.).

Drops, Van Swieten's. An aromatised solution of corrosive sublimate.

Drop, Ward's White. *Prep.* From quicksilver, 4 oz.; nitric acid, 16 fl. oz.; dissolve, add sesquicarbonate of ammonia, 7 oz.; evaporate and crystallise; then dissolve the resulting salt by the heat of a sand-bath, in 4 times its weight of rose-water. Very poisonous.—*Dose*, 5 to 15 drops, as an antiscorbutic, antivenereal, &c.

Drops, Worm. *Syn.* GUTTÆ ANTHELMINTICÆ, G. VERMIFUGÆ, L. *Prep.* 1. Creosote, 1 dr.; oil of turpentine, 7 fl. dr.—*Dose.* A teaspoonful, 3 or 4 times a day.

2. (*Peschier.*) Oil of male-fern, 3 fl. dr,; rectified oil of turpentine, 5 fl. dr. As the last; in tapeworm.

3. (*Schwartz.*) Barbadoes tar, 1 fl. oz.; tincture of assafœtida, 1½ fl. oz.—*Dose*, 30 to 40 drops, 3 times a day; in tapeworm.

DROPS (Scouring). *Prep.* 1. Oil of turpentine and oil of lemons, equal parts. Both of the ingredients should have been recently distilled or rectified.

2. Oil of lemon bottoms, 1¾ lbs.; oil of turpentine, 1 quart; mix well, and distil by the heat of a sand-bath, until 3 pints have come over, or as long as the distillate is clear, pale, and sweet. Used to remove paint, grease, &c., from cloth.

3. Strong solution of ammonia, 1 part; methylated spirit of wine, 3 parts.

4. Petroleum ether or benzoline is an excellent solvent to remove paint, grease, resins, &c. Care should be taken not to bring it near flame.

DROPSY. *Syn.* HYDROPS, L. An unnatural collection of aqueous fluid in any part of the body. Dropsy has received different names, according to the part of body affected by the disease. When it occurs in the cellular membrane it is called ANASARCA; when in the cavity of the abdomen, ASCITES; in the cavity of the cranium, HYDROCEPHALUS; in the scrotum, HYDROCELE; in the uterus, HYDROMETRA; and in the chest, HYDROTHORAX.

The treatment of dropsy, perhaps more than any other disease, depends upon the circumstances with which it is connected, and, more especially, upon those which have caused it. The acute inflammatory forms of dropsy generally require depletion. In most other cases, tonics may be advantageously administered. To promote the absorption of the accumulated fluids, diuretics are commonly resorted to.

DROSOPHILA (from Δρόσος, dew; and φιλέω, to love) **FLAVA**, Fallen. The Yellow Turnip-leaf Miner. Most farmers have noticed blisters and discoloration upon the upper surfaces of the leaves of swede and turnip-plants, which are something like the blisters caused by the *Tephritis onopordinis* upon the leaves of celery-plants. Many have not taken the trouble to examine these closely, attributing them to the action of the sun or to some accidental injury. Some, on the other hand, seeing that the appearance was unusual, and that the plants were evidently not healthy, made careful investigations, and found little white maggots, just under the skin or cuticle on the upper surfaces of the leaves, feeding upon the soft tissue known as the parenchyma. It was stated by a large turnip-grower that he was struck by the flagging of the leaves of swede-plants, and, finding the blisters, soon unearthed the maggots, the cause of the mischief. He said that he first detected maggots on the 15th of July, and that he found some in the leaves even as late as the 25th of September. From specimens sent of these, as well as of the pupæ, there was no doubt that they were the larvæ of *Drosophila flava.* Several complaints have been made of injuries occasioned to turnip-plants during the last 2 or 3 years, which from the descriptions given by the reporters were due to the *Drosophila.*

This insect is not mentioned by American entomologists, though Lintner says that there are several species of *Drosophila* in America. He adds that this genus has not been studied in that country ('Injurious and other Insects of the State of New York,' by J. A. Lintner, State Entomologist). Osten Sacken names 10 species as known in North America, but does not mention *Drosophila flava* ('A Catalogue of the described Diptera of North America,' by R. Osten Sacken).

Life History. The *Drosophila flava* in colour is yellowish, with a white face, 'silky white,' Curtis says. It is about 1-10th of an inch in length, with a wing expanse of rather more than 1-8th of an inch. The legs and wings are yellow. Eggs are laid on the upper surface of the leaves, and the maggots coming from these mine into the cuticle and feed upon the pulpy substance beneath it. These maggots are pale green, close upon 1-8th inch long, and feed in the upper surface of the leaf, just as invariably as the maggots of the *Phytomyza nigricornis* feed in the under surfaces. They change to pupæ of a brown hue. Curtis thinks that the pupæ of the second generation, or some of them, fall to the ground, to be transformed there.

Prev. Swede and turnip-tops that are cut from roots for storing must be ploughed into the ground deeply, or burnt after an attack of this insect. No leaves, decayed or otherwise, should be left above ground.

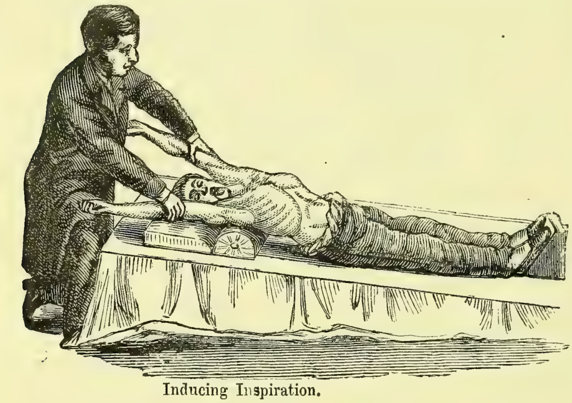
Remedies. Lime dusted upon the leaves of affected plants when the dew is on is likely to be useful. Soot or guano may be substituted for

lime ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

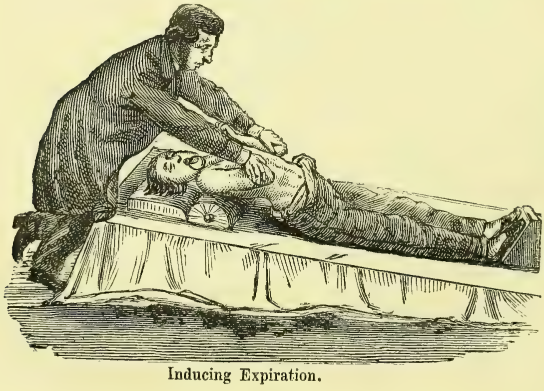
DROWNING. The cause of death from submersion in water is the entire exclusion of air from the lungs, by which the aëration of the venous blood is prevented. In consequence of this deprivation of air, venous blood circulates through the arterial system, whilst the pulmonary vein ceases to convey oxygenated blood to the heart. Under ordinary circumstances, in the course of 4 or 5 minutes after the access of air has been cut off, life becomes extinct. Many cases have, nevertheless, occurred of persons being submerged for 15 or 20 minutes, and even longer, and where perfect insensibility has existed, in which recovery has taken place.

Prev. The specific gravity of the human body is less than that of water, so long as the lungs are partially filled with air; and this difference is sufficient to keep the body floating with the mouth and nostrils free for respiration, provided the face is turned upwards by throwing the head back on the shoulders, by which the weight of the head is sustained by the water. When a person throws himself into the water, the body rises rapidly to the surface and assumes nearly the erect position, the upper part of the head, down to a little below the eyes, remaining above the surface of the water. This arises from the greater density of the legs and thighs compared to that of the chest, which acts as a species of float or buoy to the rest of the body. In this situation the head may be thrown back, so that the face may form the exposed portion as before mentioned, when respiration may be carried on without inconvenience in still water, and regularly, but sufficiently, so as to sustain life for some time, even in a rough sea. The adoption of this simple precaution would have saved thousands of valuable lives.

Another point which should be remembered by every person in danger of drowning is, that there is always a considerable amount of residual air in the lungs, in a nearly deoxidised state, and that if this air is expelled by 2 or 3 forced inspirations, and a deep inspiration is then taken, a larger quantity of pure air will be introduced into the lungs, and the blood will continue aërated for a proportionally longer time; and consequently, a longer period will elapse before another inspiration will be required. If we prepare ourselves by taking 2 or 3 forced inspirations, and then take a full inspiration, we may remain for 1½ or 2 minutes before a second attempt at respiration need be made. This is the plan adopted by the pearl fishers, and other divers who are remarkable for remaining beneath the surface of the water for some time. A person in danger of shipwreck, or expecting immediate submersion, in any other situation, should have recourse to this expedient, which would prevent the dreadful effects of attempting respiration whilst under water.



Inducing Inspiration.



Inducing Expiration.

Treatm. Turn the patient on his face to let water run out of the mouth and air-passages, and proceed as follows (*Sylvester*):

1. Place the patient on his back on a flat surface, with the head and chest a little raised on a cushion, bundle of clothes, or block; remove all clothing from the chest and neck. Do this as quickly as possible.

2. Cleanse the mouth and nostrils; open the mouth and draw the tongue forward, and *keep* it forward.

3. Imitate the movements of breathing. (*a*) Induce inspiration. Place yourself at the patient's head; grasp his arms; raise them upwards by the sides of the head; stretch them steadily but gently upwards for 2 seconds (this raises the ribs and draws air into the lungs). (*b*) Induce expiration. Turn down the patient's arms and press them firmly but gently downwards against the sides of the chest for 2 seconds (this depresses the ribs and expels foul air from the lungs).

4. Continue these movements *steadily and unremittingly* 15 *times a minute* until a spontaneous effort to respire is made by the patient.

5. Whilst you are proceeding as above, get a bystander to tickle the throat with a feather; apply smelling salts to the nostrils; rub the chest and face briskly, and dash cold and hot water on them alternately. Rub the body with a flannel or dry cloth.

6. When natural breathing is restored the patient (under medical supervision) may be put in a warm bath; wrapped in blankets; rubbed and warmed by hot bottles, &c.

7. When the patient can swallow give a *little* warm water, wine, brandy, or coffee.

Lastly, remember that the condition of the patient is *urgent*. No time is to be lost, and the efforts to restore life must be unremitting and continued until the pulse and breathing have ceased for *an hour*.

DRUGS. Substances used in medicine, sold by druggists, and compounded by pharmacists and apothecaries. Our continental neighbours, wiser than ourselves, not merely require that persons engaged in selling and dispensing drugs and pharmaceutical preparations shall be fully qualified by previous education and training for the task, but also that the various articles they sell and use shall be commercially pure and of the proper quality. In the United States of America this subject has also engaged the attention of the Government and Legislature. Under the Act of the 26th June, 1848, inspectors were appointed to examine the quality of imported articles of this class before allowing them to pass the Customs for home use. An abridged copy of the order addressed to the 'collectors and other officers under this Act' is appended, and will be useful to the reader, as assisting to establish a standard by which the value of the substances named therein may be estimated.

TREASURY DEPARTMENT, *June 4th*, 1853.

The following articles are to be entitled to entry when ascertained by analysis to afford the percentages as under, viz.:

ALOES, 80% of *pure aloetic extract.*

ASSAFŒTIDA, 50% of its *peculiar bitter resin*, and 3% of *volatile oil.*

CINCHONA BARK (of whatever denomination), 1% *of pure quinine*, or 2% of the several alkaloids, as *quina, cinchona, quinidine, aricine*, &c.

BENZOIN, 80% of *benzoin resin.*

Do. 12% of *benzoic acid.*

COLOCYNTH, 12% of *colocynthine.*

ELATERIUM, 30% of *elaterine.*

GALBANUM, 60% of *resin.*

Do. 10% of *gum*, and 6% *volatile oil.*

GAMBOGE, 70% of *pure gamboge resin*, and 2% of *gum.*

GUAIACUM, 80% of *pure guaiacum resin.*

GUM AMMONIACUM, 70% of *resin*, and 18% of *gum.*

JALAP (root in powder), 11% of *pure jalap resin.*

MYRRH, 30% of *pure resin*, and 50% of *gum.*

OPIUM, 9% of *pure morphia.*

RHUBARB (only Turkey, East Indian, and Russian admissible), 40% of *soluble matter.*

SAGAPENUM, 50% of *resin*, 30% of *gum*, and 30% of *volatile oil.*

SCAMMONY, 70% of *pure scammony resin.*

SENNA, 28% of *soluble matter.*

Medicinal leaves, flowers, barks, roots, extracts, &c., not specified above, must be, when imported, in perfect condition, and of as recent collection and preparation as practicable.

Pharmaceutical and chemical preparations, whether crystallised or otherwise, used in medicine, to be pure and of a proper consistence and strength, as well as of perfect manufacture, conformably with the standard authorities named in the Act, and must in no instance contain over 3% of excess of moisture or water of crystallisation.

Essential or volatile oils, and expressed oils used in medicine, must be pure and of the standard sp. gr. noticed and declared in the dispensatories named in the above Act.

'Patent' or 'Secret Medicines' are by law subject to the same examination as other medicinal preparations, and cannot be permitted to pass the Custom House for home consumption, but must be rejected and condemned, unless the special examiner is satisfied, after due investigation, that they are fit and safe to be used for medical purposes.

An appeal from the examiner to the collector to be admitted within 10 days.

JAMES GUTHRIE,
Secretary to the Treasury.

DRUM'MOND LIGHT. See LIGHT (Artificial).

DRUNK'ENNESS. See ALCOHOL, INTEMPERANCE, &c.

DRY'ERS (Painter's). *Prep.* 1. Litharge (best) ground to a paste with drying-oil. For dark colours.

2. From white copperas and drying oil; as the last.

3. From sugar of lead and drying oil. The last two are for pale colours.

4. From white copperas and sugar of lead, of each, 1 lb.; pure white lead, 2 lbs. For 'whites' and opaque light colours, greys, &c.

Dryers are employed, as the name implies, to increase the drying and hardening properties of oil paints. A little is beaten up with them at the time of mixing them with the oil and turpentine for use.

DRY'ING. See DESICCATION, &c.

DRY'ING-OIL. See OILS.

DRYOBALANOPS AROMATICA, Gaert. Sumatra camphor-tree. The camphor sometimes occurs in masses several pounds in weight. It does not reach Europe, being eagerly bought by the Chinese in preference to ordinary camphor, their own produce.

DRY-ROT. A peculiar disease that attacks wood and renders it brittle and rotten. It is generally caused by dampness and the subsequent development of the spores of fungi, particularly those of *Merulius lacrymans* and *vastator* and *Polyporus destructor*. The dry-rot principally attacks 'ill-seasoned' timber, and more particularly that of ships and badly-ventilated buildings. Linoleum is a fertile cause of dry-rot in houses by preventing the free ventilation of the flooring. Some London leases contain a clause prohibiting its use on certain floors.

Prev. Various means have been proposed to prevent the attacks of dry-rot and to arrest its progress when it has commenced, among which the process called 'KYANIZING' (Kyan's patent) is that most generally known and most extensively adopted. It consists in immersing the timber in a bath of corrosive sublimate. The process termed 'PAYNIZING' (Payne's patent) consists in first filling the pores with a solution of chloride

of calcium, under pressure, and next forcing in a solution of sulphate of iron, by which an insoluble sulphate of lime is formed in the body of the wood, which is thus rendered nearly as hard as stone. Wood so prepared is now largely employed in our public works and railways. Sir W. Burnett's process (patented in 1836) consists in impregnating the timber with a solution of chloride of zinc. Mr J. Bethell's process (patented in 1838) consists in thoroughly impregnating the wood with oil of tar containing creosote and a crude solution of acetate of iron, commonly called 'pyrolignite' of iron. The impregnation is effected in a strong cylindrical vessel, connected with a powerful air-pump, so that in the first instance, a vacuum being formed, and subsequently a pressure of several atmospheres applied, the liquid may as much as possible be forced into all the pores of the wood. The above processes for 'seasoning' preserve the timber not only from dry-rot but from the influence of the weather and the attacks of insects and worms.

"The construction of air-drains or passages around wood-work to be preserved is, where the method is applicable, a great aid to the preservation of wood. Dry-rot is both prevented in new buildings and cured in old ones by filling up the spaces between the floor-joists with 'tank-waste' from alkali-works. This can also be applied to the ends of beams resting in walls" ('Chemical News').

DUB'BING. *Prep.* 1. By boiling the waste cuttings of sheep-skins in crude cod oil. 2. Black resin, 2 lbs.; tallow, 1 lb.; crude cod oil or train oil, 1 gall.; boil to a proper consistence. Used by the curriers to dress leather, and by shoemakers and others to soften leather, and to render boots and shoes waterproof. Far preferable to blacking for boots; it renders them soft, pliable, and waterproof, and prolongs their existence very greatly.

DUBOISIA MYOPOROIDES. (Nat. Ord. SOLANACEÆ.) A small tree growing in Australia, New Caledonia, and New Guinea. The leaves have been used in Brisbane and Sydney as a substitute for atropine and extract of belladonna; to both of which Mr Tweedy believes them to be superior in prompt and energetic action. Mr Tweedy further states that, in every case in which he has used *duboisia* to produce dilatation of the pupil of the eye, its action has been beneficial, and, he is induced to conclude, more advantageous than that of atropine. According to Dr Ringer, *duboisia*, besides causing dilatation of the pupil, quickens the pulse, parches the tongue, stops the secretions of the skin, and induces headache and drowsiness. He also reports that it is antagonistic in its action to muscarine, and produces tetanus after the lapse of some hours or days.

For an account of the botanical properties of the plant, the reader is referred to a paper by Mr E. M. Holmes in the 'Pharmaceutical Journal' for March 9th, 1878; and to the 'Lancet' of March 2nd, 1878, for some experiments on its physiological effects by Messrs Ringer and Tweedy. The *Duboisia myoporoides* was introduced into medical practice by Dr Bancroft, of Brisbane.

Since the above was written, Mr Gerrard has obtained a powerful alkaloid from an extract of the leaves of the Duboisias, very similar in chemical properties to atropine, and possessed of the same physiological qualities as the extract. A. Ladenburg has shown that Gerrard's duboisine is isomeric with atropine and hyoscyamine, but possesses the chemical and physiological characters of hyoscyamine.

DUCK. See POULTRY.

DUCTIL'ITY is the property of being drawn out in length without breaking. See METALS.

DULCAMA'RA. See NIGHTSHADE (Woody).

DUMB'NESS. *Syn.* APHONIA, L. As speech is an acquired and imitative faculty, persons who are either born deaf or become so in early infancy are also, necessarily, dumb. The first step in treating dumbness must therefore be directed to the removal of the deafness on which the imperfection rests. The exertions of modern philanthropists have, however, been so far successful in such cases as to enable the deaf-mute to converse with those around him by signs, and by watching the movements of the lips of speakers.

DUMPLINGS, Norfolk. Mix half a pound of flour with half a teaspoonful of baking powder and a pinch of salt; make into a little dough with cold water; divide into small balls, put them into boiling water immediately, and boil for 20 minutes.

DUNGER — MANURE (*Boutin*, Paris.). A bluish-green fluid, containing about 190 grms. of solid matter per litre. The residue consists of sulphates of copper, iron, magnesia, and soda, sal-ammoniac, nitrate of potash, and soda, common salt, and none or a mere trace of phosphoric acid. The blue deposit which separates on standing is ultramarine (*Keller*, *Karmro* , and *Nessler*).

DUNG'ING. *Syn.* CLEANSING. One of the principal processes in the art of calico printing and dyeing, its object being to free the cloth from loose matters, which would interfere with the dyeing. After the thickened mordants have been applied to the fabric and properly fixed, it is necessary to remove the now useless thickening matter, together with the excess of mordant, which has not come into actual contact with the cloth. Formerly a bath formed of cow-dung, diffused through hot water (130° to 212° F.) was always used to wash away these loose matters; but now various manufactured substances are successfully employed for the purpose. The best dung substitutes are the arsenite and arseniate soda, the silicate of soda, and phosphate of lime. Experience proves that, in the case of these substitutes, a final wince in cow-dung before dyeing is advantageous. A process very similar to 'dunging' is employed after dyeing, to clear and give purity to the undyed parts. This subsequent process is distinguished by the term 'clearing.' Cow-dung has been used in 'clearing' operations, but its employment is not to be recommended. Bran scalded and mixed with water is employed for certain goods, but bleaching powder is the most generally used 'clearing agent.'

DURIAN FRUITS (*Durio zibethinus*, L.). A tree cultivated in Malacca and the Malay Islands. By those who have overcome its civet odour and

turpentine flavour, it is ranked among the most delicious of fruits.

DUST, ATMOSPHERIC. When a ray of sunlight is admitted into a dark room, or an electric beam is transmitted through a glass tube, myriads of little motes are revealed which move and dance about in all directions.

In ordinary daylight these minute particles are invisible. Nevertheless, they are always more or less present in the atmosphere wherever (except under special conditions) this permeates, and they constitute that more or less attenuated, impalpable, generally dry, or desiccated form of matter which we denominate dust.

As with every inspiration we take into our bodies more or less of this suspended material, the study of the composition and characters of the different substances which compose it is one possessed of paramount interest, both for the pathologist and sanitarian.

Amongst solid, inorganic matters found in the open air are silica, peroxide of iron, silicate of alumina, carbonate and phosphate of lime, sand, carbon, chloride of sodium, and metallic iron. These, of course, are of telluric origin, and are carried into the atmosphere by strong currents and winds, which latter have the power of transporting dust to great distances, *e. g.* red sand from the interior of Africa has been found in the sails of ships 600 or 800 miles distant from the African coast, whilst particles of carbon, sand, and dried mud, ejected to great heights from volcanoes into the air, have been transported over still greater distances.

Some doubt appears to prevail as to whether all dust-storms originate on the earth, it having been conjectured that some solid matters found in the atmosphere may be of meteoric origin, and may have entered it from the realms of space. The chloride of sodium (which the chemist knows is so omnipresent that he cannot heat an ordinary platinum wire in a Bunsen burner without indications of its presence) is derived from the spray of the sea, lifted and diffused into the air by the wind; the iron dust from the rails over which railway trains are constantly passing; the silica, amongst other sources, from the traffic over macadamised thoroughfares.

The organised and organic substances contained in the external air are very numerous. The animal kingdom is the source of the wings of moths, butterflies, and other insects, spiders' legs and webs, hair, wool, epithelium, and eggs, many of these bodies being mere *débris*.

The vegetable kingdom contributes spores, pollen, cells, cotton fibre, and the germs of vibriones and monads. Besides these are many living creatures, brought by the agency of monsoons and cyclones from extensive deserts. Showers of sand derived from these wastes occur in different parts of Europe. Ehrenberg submitted the sand obtained during 70 of these showers to microscopic examination, and found, in addition to sand and oxide of iron, numerous organic forms, amongst which were 194 Polygastrica, 145 Phylolitharıæ, besides Polythalmia, &c. Silvestre found 4 species of diatoms and living Infusoria in the sand obtained from a dust-shower in Sicily in 1872. But, besides the presence of these organisms in the external air, which may be regarded exceptional, it contains, under ordinary conditions, numerous living creatures, some brought into it from the earth by the force of winds, others growing in it. More than 200 forms —rhizopods, tardigrades, and Anguilulæ—have been found in it by Ehrenberg. So tenacious of life are these latter that, even if dried, they will retain their vitality for months, and even years.

Of the organisms found in the air the following are the most important:—"1. Extremely small, round, and oval cells, which, that they may be rightly examined by the microscope, require a power of 600 or 1000 diameters. They are found sometimes growing together and sometimes cleaving, when they present an appearance like the figure 8. Sulphuretted hydrogen in the air is said to stimulate their growth, and carbolic acid to check it. Although existing in the open air, they are by far more abundant in the atmosphere of dirty prisons. They are also met with in the sweat of the prisoners inhabiting these localities. Observers believe they increase rapidly by cleavage. No ill effects have been traced to them.

"To the same class, perhaps, of these round and oval cells the bacteria and monads, which have been described as gathered from the air, must be assigned; the development of these cells into vibriones and rod-like bacteria, though asserted, has not yet been definitely proved, and, indeed, Burdon-Sanderson's observations rather throw doubt on the statement that true bacteria exist in the air.

"2. Spores of fungi are not infrequent in the open air; they occur most commonly in summer (July and August); they are not in this country more frequent with one wind than another; the largest number found by Maddox in 10 hours was 250 spores; on some days not a spore can be found. Maddox leaves undetermined the kind of fungus which the spores developed under cultivation; the spores were pale or olive-coloured and oval, probably from some form of smut. Angus Smith found in water, through which the air of Manchester was drawn, innumerable spores. Mr Dancer has calculated that in a single drop of the water 250,000 fungoid spores as well as mycelium were present; but as the water was not examined for some time there may have been growth. Mycelium of fungus seems uncommon in the air, but is sometimes found.

"The cells of the *Protococcus pluvialis* are not uncommon; neither, perhaps, are those of other algæ. On the whole, the experiments of Maddox show that in his locality (near Southampton) it is incorrect to speak of the air being loaded with fungoid spores; they can be found, but are not very numerous" (*Parkes*).

Amongst other suspended matters are minute fragments of dried horse-droppings, derived from the original substance, reduced to powder by the traffic, and carried by aërial currents into the atmosphere. In the 'Chemical News' for October, 1871, Professor Tichborne gives the results of some analyses of the street-dust of Dublin. Some dust taken from the top of a pillar 134 feet high contained 29·7% of organic matter, whilst that collected from the street consisted of as much as 45·2%. This organic matter was prin-

cipally composed of comminuted stable manure; it was capable of acting as a ferment, and was possessed of deoxidising powers sufficient to reduce nitrate to nitrite of potash.

This evidence of the presence of suspended known matters in the air has led some pathologists to conjecture that certain formless substances found in it, undeterminable by the microscope, may in reality be disease germs, which, being transported through long distances by the wind, may also be the means of spreading certain maladies from one locality to another. In this manner cholera has been supposed to have been propagated from India, the particles of the dried excreta of cholera patients being supposed to be the carriers of the formidable disease; this hypothesis of its origin, however, is not yet, at any rate, universally accepted. "In the case of smallpox and scarlet fever the distance to which the 'contagions' spread by means of the air is certainly inconsiderable" (*ibid.*).

Hitherto we have spoken only of the nature of the dust occurring in the external air. The composition of that met with in confined spaces is, of course, largely influenced by surrounding conditions and circumstances; for instance, in indifferently ventilated apartments, in addition to the substances already enumerated, the dust of the confined air has been found to contain small particles of food, bits of the hair of human beings, domestic animals, and feathers of birds, as well as of coals, cinders, charred wood, linen, cotton, and wool fibres, varieties of epithelium, and certain round cells resembling nuclei.

In the apartments of the sick it is additionally charged with a very large quantity of organic matter.

The spores of the Tricophyton and Acorion have been discovered in and seem peculiar to skin hospitals. In dust taken upon two occasions from the ward of St Louis (the Skin Hospital of Paris), and submitted to examination, one specimen was found additionally to contain 36%, and in the other 46% of organic matter.

"The scaly and round epithelia found in most rooms are present in large quantity in hospital wards, and probably in cases where there is much expectoration and exposure of pus or puriform fluids to the air the quantity would be still larger" (*Parkes*).

The investigation of the air of a cholera ward in 1849 by Britain and Swayne, at Clifton, revealed the presence of bodies resembling fungi; minute scales of variolous matter have been found by Bakewell in smallpox wards, and cells of pus and epithelium in the sheds and stables of animals affected with cattle disease and pleuro-pneumonia. Dr Watson detected in the air of a ward for consumptive patients at Netley, together with pus-cells, bodies bearing a resemblance to the cells met with in tuberculous matter, these latter not being discoverable in the open air or in the rooms of non-consumptive persons; whilst Rainy, examining the air of the cholera ward of St Thomas's Hospital, found bacteria in it, besides fungi. The presence of these bodies was, however, detected in the open air.

The atmosphere of mines, workshops, manufactories, and rooms in which handicraft of any kind is carried on, is more or less laden with small particles of substances employed in the arts, manufactures, and various industries.

Dr Wynter Blyth gives the following instructions for collecting atmospheric dust for examination:

"The most simple way to obtain the emanations from a sick room for microscopical observation is to suspend a common water-bottle from the ceiling filled with iced water. The moisture of the air condenses and brings with it organic matters; or the moisture may be gathered which adheres to panes of glass in cold weather; or a bottle may be taken containing some distilled water, absolutely free from impurities of any kind, and filled several times with the air of the place. The water may then be submitted to microscopical and chemical examination.

"Metallic dust, such as iron, may be attracted by a magnet. The most usual and successful way is, however, by *aspiration*, either by an aspirator made for the purpose [see ASPIRATOR], or by means of an ordinary cask, by which a considerable volume of air is drawn through a small quantity of distilled water, glycerin, or other liquid. The indirect way for the organic matter, &c., mentioned above, viz. analyses of the rain-water, and the obvious way of collecting the dust by carefully sweeping it off shelves, &c., may be also enumerated.

"*Examination of Dust.* The dust obtained by any or all of these methods should now be examined microscopically and chemically. Low powers should be used at first, and then (if looking for germs) the highest that can be obtained. If the dust is in any quantity it can be submitted to chemical examination, but a knowledge of what class it belongs to — animal, mineral, or vegetable—is sufficient for most purposes" ('Dict. of Hygiene').

DUST-BIN. A dust-bin on any premises may become a nuisance and a peril to health if certain precautions are not observed with respect to it.

It should have a tolerably tight-fitting cover, and one that is waterproof also especially, if, as it ought to be, the dust-bin is situated in the open air. The bottom should never be the bare earth, but one that is properly bricked or tiled. It should be lime-washed occasionally, in summer-time the most frequently. Only dry refuse, such as ashes and the sweepings of rooms, &c., should be thrown into it.

On no account should fragments of vegetable or animal nature be put in, such as fish-bones, potato parings, cabbage stalks, dirty or discarded pieces of apparel, or bits of rags or dusters. These should be at once burnt on the kitchen fire; the best kind of stove for consuming these is that known as the kilnhouse. Meat bones should be disposed of as soon as possible, as they frequently give rise to unpleasant and offensive odours. Finally, the dust-bin should not be too large. If too capacious, it acts as a guile for servants not to have it cleaned out as often as it should be, the frequent removal of its contents being a most essential condition toward the preservation of health. See ASH-PIT.

DUSTING. This very important branch of household labour is sometimes very inefficiently

performed. Very frequently the dust of an apartment is not removed, but merely disturbed or driven from one place to settle down on another.

It should always as much as possible be got rid of by means of a duster or a brush and dust-pan.

As the dust should adhere to the former, this should from time to time be taken out into the open air and shaken. During the time a room is being dusted the furniture should be collected in as small a space as possible, and enveloped in the dusting-sheet. The dusting-sheet on its removal should be carefully folded together, taken into the air and shaken. The furniture may then be dusted and returned to the proper places.

A duster should never be rubbed over furniture standing close to a wall, or a dirty mark on the wall-paper will be the result. The same caution applies to mantelpieces, where the paper may soon be spoilt by the act of dusting, unless contact with the duster be avoided.

DUST-TRAPS. Some cupboards and drawers seem to have the power of attracting dust. A little consideration will show that there is sufficient reason for expecting that dust will accumulate in such places. Dust is carried about only when the air is in motion, and it begins to settle as soon as the motion ceases. It will naturally settle on any ledges or the edge of cracks. How does it get driven through the cracks or narrow spaces round the doors? A difference of 1 inch in the height of the barometer is due to a difference of pressure of about 1-30th, and since the volume varies inversely as the pressure, the volume will vary by about 1-30th. A cupboard measuring 4 feet by 4 feet by 2 feet, will contain about 30 cubic feet of air, allowing for shelves. If it is closed when the barometer is low, and a rise of 1 inch should take place, in order that equilibrium may be restored, about 1 cubic foot of air will have to find its way into the cupboard. The pressure with which it will be forced in will at first be about ½ lb. to the square inch, or 72 lbs. to the square foot. A difference of 15 degrees of temperature will produce the same result, and it may happen that the two causes may act at the same time. Unless very considerable care is taken in fitting the doors, it is probable that equilibrium will soon be restored, and any dust that has settled on the ledges will be drawn in; as soon as it is inside, the air being still, it will settle, and will not be ready to be blown out at the next change. The pressure within the cupboard will be reduced every time the door is opened, the door acting like a piston. This is likely to draw in any dust that is lying near. Cabinets for specimens, &c., should be arranged with flaps or guards to every ledge or crevice, taking care that they do not act as receptacles for dust in themselves.

The best remedy, however, has been devised by an American curator, who provides each cupboard or drawer with a dust-trap. This consists of a large hole at the back, covered both inside and outside with a piece of wire gauze, and the space between, corresponding to the thickness of the board, is filled with cotton-wool. Any change of pressure, due either to natural meteorological causes or to the opening and shutting of doors, will produce a displacement of air in this hole. The air meets with scarcely perceptible resistance, all dust lying on the wire gauze is stopped by the cotton, and the result is perfect absence of dust (*Work*).

DUTCH DROPS. The dark-coloured residue left by the dry distillation of turpentine (*Hager*).

DUTCH GOLD. See ALLOY.

DUTCH LIQ'UID. See OLEFIANT GAS.

DYE'ING. The act of tingeing or colouring absorbent materials by impregnating them with solutions of colouring matters or dye-stuffs. The colouring matters which impart their tints without the intervention of other substances are called 'substantive colours'; while those which require such aid are called 'adjective colours.' The bodies employed to fix and develop the latter class are called 'mordants.' The exact way in which dye-stuffs act upon fibrous materials has not yet been investigated as fully as it deserves; the generally received opinion is that the fibre has a chemical affinity for the colouring matter in the case of substantive dyes, and likewise for the mordant, which, in its turn, has an affinity for the colouring matter of adjective dyes. Another opinion is that the fibres have pores, which, when expanded by heat or chemical agents, admit particles of colouring matter. However this may be, it is certain that different materials 'take' dyes in different proportions; thus, silk and wool take the coal-tar dyes in the most perfect manner, but cotton requires the intervention of a most powerful mineral or animal mordant. WOOL takes the colouring matters of most dye-stuffs so well that the deepest tints can readily be produced. SILK and COTTON are dyed with greater difficulty, whilst LINEN shows still less disposition to take dyes. The operations which take place in dyeing are 'mordanting,' 'ageing,' 'dunging,' 'dyeing,' and 'clearing.' The first of these operations is noticed under MORDANT. After the fabric has been mordanted, it is generally hung up in a room through which a current of steam and air is passing, by means of which the union between the fibre and the mordant is quickened very considerably. This exposure to moist air is the step in the process to which the term 'ageing' is applied. The operations of 'dunging' and 'clearing' are noticed above (see DUNGING). The 'dyeing' proper, which follows the 'dunging,' is effected by running the fabric through the solution of the dye-stuff, the colour being modified more or less by the nature of the mordant used. Under the names of the different colours the means used to dye such colours are minutely described. See BLACK DYE, BLUE DYE, &c.

The following particulars respecting the production of the more common colours may prove interesting to the reader who merely requires some general information on the subject:

BLACK is usually produced by logwood or galls with an iron mordant. Common black silks are dyed with logwood and fustic, iron being used as a mordant. The best silks are dyed black on a blue ground. Woollen goods are first dyed blue with indigo, and afterwards with sumac, logwood, and green or blue copperas. Cotton and linen goods are dyed black in a very similar manner.

BLUE is commonly produced from indigo, either in the form of sulphate or in aqueous solution. Prussian blue, with a persalt of iron or tin as a mordant, gives a very splendid dark blue. Of late several blues of novel shades have been produced from coal-tar.

RED is obtained in various shades by using cochineal, safflower, lac-dye, madder, or logwood, with a tin mordant.

PURPLE. Until the last few years the dyer was dependent for his purples on orchil or cudbear, but he has now at his disposal the magnificent series of aniline, or coal-tar colours, ranging from the most delicate violet, or 'mauve,' to the full crimson-purple known as 'magenta.' See PURPLE DYE.

YELLOW. The most important yellow dyes are made from quercitron, fustic, turmeric, arnotto, and French and Persian berries. For further information, see BLEACHING, CALICO-PRINTING, &c.

DYER'S SPIRITS. See TIN MORDANTS.

DYES. See DYEING, and the names of the principal colours.

DYE-STUFFS. The colouring materials used in dyeing are so called. The more important of them are noticed under the respective names.

DYNAMITE. Nobel's dynamite consists of a mixture of 75 parts of nitroglycerin incorporated with 25 parts of an infusorial earth known as 'kieselghur,' found at Luneburgh, and consisting of the fossil shells of Infusoria. Kieselghur is almost pure silica. Dynamite is in regular use on the Continent for mining operations, and its manufacture and transport appear to be subject only to reasonable precautions. If ignited in the open air, or even when loosely packed, it burns quietly away, with the evolution of a small quantity of nitrous acid. Although the first cost of dynamite is four times that of gunpowder, it is said to be really only half as expensive, since it possesses eight times the explosive power of the latter; added to which the labour of boring blast-holes is avoided. It also possesses the advantage of not being impaired in efficiency by damp.

When required for use the dynamite is rammed into a thick paper cartridge, into which a fusee is passed, by means of which it is ignited. Although dynamite when once made may be comparatively harmless until exploded at will, that great risk is incurred in its manufacture may be inferred from the fact that upon two occasions the manufactory on the Continent in which it is prepared has been twice entirely destroyed. On the occasion of the last accident it was impossible to learn the cause of the disaster, since every one in the building was blown to atoms.

Diralin is said to be a mixture of nitroglycerin with sawdust or wood-pulp as used in paper-mills, the two latter substances having been previously treated with nitric and sulphuric acids.

DYS'ENTERY. *Syn.* BLOODY FLUX; DYSENTERIA, L. A disease arising from inflammation of the mucous membrane of the large intestines, and characterised by stools consisting chiefly of blood and mucus, or other morbid matter, accompanied with griping of the bowels, and followed by tenesmus. There is generally more or less fever, and the natural fæces are either retained or discharged in small, hard balls (*scybala*). The common causes of this disease are marsh-miasma, bad water, improper diet, excessive exhaustion, and fatigue, and, above all, exposure to the cold and damp air of night after a hot day.

Treatm. The common dysentery of this country generally gives way to gentle aperients (castor oil or salts-and-manna), to cleanse the bowels, followed by mild opiates or morphia, to allay irritation. The chronic symptoms, which frequently hang about for some time, are best combated by mild tonics and vegetable bitters (bark, calumba, cascarilla). Occasionally, chalybeates (ammonio-citrate of iron, lactate of iron, wine of iron, saccharine carbonate of iron) will be found useful during convalescence. Throughout, the diet should be light and nutritious, and, in the active stage of the disease, in a liquid form.

The dysentery of camps and hot climates is a severe and fatal disease, in which the preceding symptoms are complicated with remittent or typhoid fever. Its treatment is tedious and difficult, and depends on judiciously meeting the several symptoms as they develop themselves. Aperients, diaphoretics, and nauseants, followed by tonics, are the remedies generally relied on. The febrile symptoms must be treated according to their inflammatory or putrid tendency. This variety of the disease frequently gives rise to organic diseases of the abdominal viscera, dropsy, &c. It is regarded by some as contagious, but this is not as yet satisfactorily proved.

DYSMENORRHŒ'A. See MENSTRUATION.

DYSPEP'SIA. [L.] *Syn.* DYSPEP'SY, INDIGESTION. This complaint pervades every rank of society, and is, perhaps, of all others the most general. Few indeed are there who wholly escape it in one or other of its forms. The common symptoms of dyspepsia are—want of appetite, sudden and transient distensions of the stomach, frequent eructations, heartburn, stomachic pains, occasional vomiting, and, frequently, costiveness or diarrhœa. Sometimes the head is affected, and dimness of sight, double vision, muscæ volitantes, and slight vertigo are experienced, along with a multitude of other symptoms, depending on a derangement of the functions of the nervous system.

The causes of dyspepsia are numerous. It is a common consequence of over-indulgence in the luxuries of the table, of late hours, or of the want of proper exercise, both of body and mind. In the studious and those who lead a sedentary life it is usually caused by excessive mental exertion or anxiety, or by the fatigues of business and the want of sufficient bodily exertion and of pure air. It is a common result of inebriety, or a deficiency of proper food and clothing, bad ventilation, &c.; and is not unfrequently occasioned by the physical powers being overtaxed, especially soon after meals.

The treatment of dyspepsia depends less on medicine than on the adoption of regular habits of life. Moderation in eating, drinking; early rising, due exercise, and retiring to rest at an early hour will do much to restore the tone both of the stomach and nerves. Excessive study and mental exertion should be avoided, and recourse should frequently be had to society and amuse-

ments of a lively and interesting character. If the bowels are confined, mild aperients should be taken, and if diarrhœa is present, antacids and absorbents may be had recourse to with advantage. The stomach may be strengthened by the use of mild bitters, tonics, and stimulants, and sea-bathing, or the shower or tepid bath may be taken, when convenient, to strengthen the nervous system. When dyspepsia is a secondary or symptomatic disease the cause should be sought out, and the treatment varied accordingly. Among the aperient medicines most suitable to dyspepsia may be mentioned—Epsom salts, phosphate of soda, and Seidlitz powders, each of which should be taken largely diluted with water. Among antacids are the bicarbonates and carbonates of potassa and soda, either of which may be taken in doses of half a teaspoonful dissolved in water; or, if the spirits are depressed, 1 or 2 teaspoonfuls of spirit of sal volatile will be more appropriate; and in cases accompanied by diarrhœa, a little prepared chalk. As bitters, the compound infusion of orange peel, and of gentian are excellent. As tonics, small doses of bark or of sulphate of quinine, to which chalybeates may be added if there is pallor of countenance or a low pulse, with no disposition to fever or headache.

When dyspepsia is complicated with hysteria, hypochondriasis, or chlorosis, the treatment noticed under those heads may be conjoined to that above recommended. For the great bulk of dyspeptics the advice to live on 6*d*. a day and earn it by manual labour is thoroughly sound; half the dyspepsia in the world may be cured by sufficient physical exertion to prevent the patient having time to think of his or her internal economy and its supposed derangements.

DYSPNŒ'A. Difficulty of breathing. It is generally symptomatic of some other affections, and will require to be treated accordingly.

DYSU''RIA. [L.] *Syn.* DYS'URY. Difficult urination. It is generally symptomatic of disease of the kidneys, bladder, or urethra. The treatment depends on the exciting cause.

EAGLE-WOOD or **LIGN-ALOES.** See ALOE.

EAR (Inflamma'tion of). *Syn.* OTITIS, L. This affection, when it attacks the internal part of the ear, is generally accompanied with confusion of sound, deafness, and more or less fever. It is most frequent among children, and is commonly produced by exposure to draughts of cold air, and, occasionally, by foreign matters, as cherry-stones, insects, &c., having got into the external ear. In such cases the removal of the offensive matter, and due attention to warmth and cleanliness and general health, with a dose of laxative medicine, will be all the treatment required. The pain may generally be relieved by throwing warm water into the ear by means of a syringe, and fomenting the surrounding parts with decoction of poppy-heads and chamomile flowers. Should this treatment not succeed, a drop or two of laudanum, with 1 drop of oil of cloves and a little oil of almonds may be dropped in the ear, and a piece of cotton wool introduced afterwards. Cases of acute inflammation of the internal ear are occasionally met with in adults, which assume a very serious character, and demand the most careful treatment. See DEAFNESS.

EARTHENWARE AND GLASS (to prevent the Cracking of). When quite new, all vessels of glass and earthenware should be laid to soak in cold water, and after some hours this water, covering the vessels, should be gradually heated to the boiling-point. It is a good plan to place a little hay on the top of the water.

Glass and earthenware vessels thus treated are far less liable to crack when subjected to the heat of boiling water than they would otherwise be.

EARTH-NUT. See ARACHIS HYPOGŒA.

EARTHS. In *chemistry*, a group of metallic oxides. The principal earths are baryta, strontia, lime, magnesia, alumina, berylla or glucina, yttria, zirconia, and thoria. The first four are termed ALKALINE EARTHS; the remainder, together with the oxides of the very rare metals erbium, terbium, norium, cerium, lanthanum, and didymium, constitute the EARTHS PROPER.

The term *earth* was very loosely applied by the older chemical and pharmaceutical writers, and is still at the present day. Thus, ABSORBENT EARTH (chalk); ALUMINOUS E.; ARGILLACEOUS E. (alumina); BOLAR E. (bole); BONE-E. (phosphate of lime); FULLER'S-E. (an absorbent clay); HEAVY E. (baryta); JAPAN E., or TERRA JAPONICA (catechu); SEALED E. (bole), &c., are names even now frequently encountered both in trade and in books.

EAU. [Fr.] Water. This word, like its English synonym, is applied to numerous substances, differing in their composition, sensible properties, and uses, of which the following are a few useful examples:—EAU DOUCE, fresh or river water; EAU DE MER, sea or salt water; EAU DE FONTAINE, EAU DE SOURCE, spring water; EAU DE PUITS, well or pump water; EAU DE RIVIÈRE, river water; EAU DISTILLÉE, distilled water; EAU DE ROSE, rose water; EAU DE VIE, brandy; EAU DE COLOGNE, Cologne water; EAU D'HONGRIE, Hungary water; EAU BÉNITE, holy water; EAU FORTE, aquafortis; EAU DE SAVON, soapsuds; EAU DE SENTEUR, scented water, &c.

Eau Athenienne. (Hte. Bourgeois, Paris.) Pour nettoyer la tête et enlever les pellicules—for cleaning the head and removing scurf. An alcoholic solution of potash soap, with some solution of potash and aromatic oil (*Dr F. Goppelsröder*).

Eau Berger, for dyeing the Hair. Two fluids for consecutive application. No. 1 is a solution of 1·3 grms. sulphate of copper, ·25 grm. nitrate of nickel, 30 grms. distilled water, 4 grms. ammonia. No. 2 is a solution of calcium sulphide, made by passing sulphuretted hydrogen into milk of lime until it ceases to be absorbed, and then filtering from the excess of lime (*W. Engelhardt*).

Eau d'Afrique, for dyeing the Hair Black. Three fluids to be consecutively applied. No. 1 is a solution of 3 parts nitrate of silver in 100 parts water. No. 2 is a solution of 8 parts sodium sulphide in 100 parts water. No. 3 is a solution of nitrate of silver, like No. 1, but perfumed (*Reveil*).

Eau d'Atirona. An elegant fluid cosmetic soap, by the use of which all imperfections of the skin will be easily and painlessly removed. It consists of 25 grms. of a spirituous tincture of

cinnamon and cloves, 4 grms. soda soap, and a drop of peppermint oil (*Wittstein*).

Eau de Bahama. A black dye for the hair. It is a solution of sugar of lead perfumed with oil of anise, and containing flowers of sulphur in suspension (*Reveil*).

Eau de Beauté, Eau de Paris sans pareille, or Eau de Princesses (*August Renard*, Paris); with a German title, 'Rhümlichst bekanntes cosmetisches Wasser genannt Prinzessen-Wasser.' The well-known and renowned cosmetic called Princesses' Water. To experience the brilliant effects of this marvellous fluid we need only, after washing, habitually pass a small sponge moistened with the fluid gently over the skin, and allow it to dry without rubbing. By so doing our complexion will remain white, smooth, clear, and soft, even to extreme old age. Those, however, who are troubled with freckles, heat-spots, or any other eruption should use the water several times a day as directed. They need suffer no longer from any defect of the skin. Princesses' Water when shaken is a milk-white fluid contained in an oval bottle with a long neck, which holds 125 grms. On standing it deposits a white precipitate. It is made from 2·5 grms. calomel, ·45 grm. corrosive sublimate (so altered by the added perfume that the usual tests do not reveal it), and 122 grms. orange-flower water. The ingredients of this mixture are very poisonous.

Eau de Botot. A mouth wash. Tincture of cedar wood, 500 grms.; tincture of myrrh and tincture of rhatany, of each 125 grms.; peppermint oil, 5 drops (*Winkler*).

Eau de Capille. (*Kamprath* and *Schwartze.*) A hair dye. A mixture of 16 grms. glycerin, 8 grms. hyposulphite of soda, 1 grm. sugar of lead (or an equivalent quantity of liq. plumbi subacet.), about 2 grms. precipitated sulphur, and 130 grms. water, perfumed with a small quantity of eau de Cologne (*Hager*).

Eau de Charbon, Dr Chattam's. (*A. Ahnelt*, Charlottenburg, the African traveller.) A prophylactic and specific against syphilis. 150 grms. of a slightly red fluid, consisting of a watery solution of carbolic acid coloured with aniline and perfumed with 1 drop peppermint oil and 8 drops chloroform dissolved in 20 grms. spirit (*Hager*).

Eau de Cythère. A hair dye. A solution of 4 parts chloride of lead and 8 parts crystallised hyposulphite of soda in 88 parts distilled water (*Hager*).

Eau de Docteur Sachs. For promoting the growth of the hair, preventing its turning grey, for protecting the scalp from all injurious influences, and for preserving it in a state of purity and health. A solution of castor oil in spirit containing picrotoxin (*Dr C. Schacht*).

Eau de Fée—Fairy Water. (*Lattke*, Chemiker, Kiel.) A natural hair wash. Recommended as a preparation consisting solely of harmless vegetables (?). It consists mainly of a strong solution of nitrate of lead (*Himly*).

Eau des Fées—Fairy Water. A hair wash. A solution of $1\frac{1}{4}$ parts lead sulphite in about 3 parts sodium hyposulphite, $7\frac{3}{4}$ parts glycerin, and 88 parts water. According to the directions for use, more than three bottles of 120 grms. of the Fairy Water should not be used before the hair has been treated with Eau de Poppée, and, to raise it to the highest possible degree of beauty, with Huile régénératrice d'Hygie (*Hager*).

Eau de la Floride. A colourless fluid with a greenish-yellow deposit consisting of sugar of lead, 50 parts; flowers of sulphur, 20 parts; distilled water, 1000 parts (*F. Eymael*).

Eau de Hebe. For freckles. To be applied with a small sponge in the evening and washed off in the morning. Lemons, cut small, digested in a closed flask with distilled vinegar, lavender vinegar, oil of lemon, and rosemary, and filtered.

Eau de Java Anticholerique is a solution of camphor and carbolic acid in spirit (*Casselmann*).

Eau de Lechelle may be replaced by a filtered mixture of 200 parts aqua aromatica, 300 parts aqua dest., 10 parts acid. carbol., 10 parts ol. thymi, 20 parts acid. tannic.

Eau de lys de Lohse. (*Lohse* formerly—before the French war—*Lohsé*, Berlin). A cosmetic consisting of 2 grms. zinc oxide, 2 grms. prepared talc, 4 grms. glycerin, and 200 grms. rose water (*Schädler*).

Eau de Mont Blanc. A hair dye. A solution of nitrate of silver.

Eau de Naples. Neapolitan washing solution. A mixture of 12 parts borax, 100 parts distilled water, 50 parts rose water, 1 part camphor, 4 parts tinct. benzoin (*W. Hildwein*).

Eau de Quinine—Glycerin Hair Wash, with Extract of Peruvian Bark. (*A. Heinrich*, Leipzig.) For removing scurf and strengthening the hair. 2 grms. balsam of Peru, 6 grms. castor oil, 60 grms. rum, 35 grms. water, 5 grms. tincture of red cinchona (*Hager*).

Eau de Vienne. A hair dye from Paris. Two fluids, one of which is a solution of nitrate of silver in ammoniacal water, and the other a solution of pyrogallic acid.

Eau Dentifrice des Cordillères. An Indian recipe. 360 parts strong spirits, 330 parts water, $2\frac{1}{2}$ parts extract of red or yellow cinchona, 1 part oil of cinnamon, 2 parts oil of cloves, 3 parts oil of anise, 5 parts oil of peppermint (*Hager*).

Eau Dentifrice de Mallard. Star-anise, common anise, cinnamon, cloves, of each, 8 parts; guaiacum wood, 10 parts; brown cinchona, 6 parts; rose leaves, 5 parts; nutmegs, 2 parts, are placed in a displacement apparatus and percolated with 3 parts cochineal, 12 to 15 parts water, 1000 parts sp. vini; sp. gr. ·860. The tincture is displaced with water and 100 parts are mixed with 7 parts of a mixture of peppermint oil, spirit of scurvy-grass, and tinct. of benzoin, allowed to stand and filtered.

Eau Ecarlate—Scarlet Water. (*Bürdel.*) For renovating red linen and woollen fabrics. Oxalium, 25 parts; soda, 16 parts; potash, 5 parts; water, coloured with cochineal and slightly perfumed, 1000 parts (*Sauerwein*).

Eau Lajeune. A hair dye. An elegant pasteboard box, in which are 3 bottles of fluid and 2 bone-handled tooth-brushes. No. 1 contains a clear fluid consisting of pyrogallic acid 1·5 grms., ·3 grm. colouring matter of alkanet, 17·5 grms. spirit of wine, 27 grms. water. No. 2 is filled with a thick brown fluid, which from decomposition has produced a deposit sometimes brown,

sometimes grey. This partly decomposed fluid was originally a mixture of silver nitrate, 3·5 grms.; ammonia, 4·5 grms.; gum arabic or some similar mucilage, 2·5 grms.; distilled water, 23 grms. No. 3, labelled 'Fixateur,' contains 7·5 grms. fluid, consisting of ·5 grm. sodium sulphide, 7 grms. distilled water. The directions for use, translated into various languages, say: Dissolve 10 grms. subcarbonate of soda in half a litre of warm or cold rain-water, and with this wash the grease from the hair. Afterwards rinse it in clear water, and dry it thoroughly with a cloth. Pour 1 part of fluid No. 1 into a saucer, and with brush No. 1 apply it to the roots of the hair. Allow it 2 or 3 minutes to dry, then rub the hair with an old linen cloth to remove the superfluous moisture. Next repeat the operation, using fluid and brush No. 2, and without waiting wash the hair with warm or cold soapy water. This hair dye is quite harmless, and leaves no marks on the skin behind it.—*To use it for the Beard.* The process is the same as that for the hair, except that instead of the soda solution, ordinary soap is to be used to cleanse the beard from grease. It often happens that when the user of the dye has not taken ordinary care in cleansing the hair, the latter becomes of a false and unnatural tint. In this case the Fixateur should be used. A small sponge should be moistened with this and passed over the hair, which will make the colour natural and glossy. The Fixateur as well as the sponge must only be used in this way. It may be employed 2 days after the first operation without it being necessary to dye the hair anew (*Hager*).

Eau Medicinales are either simply watery solutions (HYDROLÉS, HYDROLATURES, SOLUTIONS PAR L'EAU), or distilled water (EAUX DISTILLÉES); or they are vinous or alcoholic tinctures or solutions of essential oils, aromatics, or more active drugs. See CORDIALS, HAIR DYES, PERFUMERY, SPIRITS, TINCTURES, WATERS, &c.

Eau Tonique de Chalmin is a perfumed solution of tannin.

Eau Tonique Parachute des Cheveux. To prevent the falling off of the hair. Macerate some pieces of violet root for some days in 120 grms. rose water, filter, and add to the fluid 2 decigrms. sulphate of iron, 3 drops vinegar, 1·3 grms. each of tincture of benzoin and balsam of Peru, 7·5 grms. Provence oil, and 10 drops oil of bergamot (*Dr Casselmann*).

Eau Virginale. (*Chable.*) Lead acetate, zinc sulphate, of each, 1 part; distilled water, 28 parts; eau de Cologne, 12 parts. Dissolve and mix; allow to stand for a month, and filter. A spoonful mixed with a glass of water to be used as a vaginal injection (*Reveil*).

Eaux, in perfumery, are solutions of the fragrant essential oils in spirit, as eau de Cologne, eau de bouquet, &c.; or they are diluted waters, largely charged with the odorous principles of plants, as eau de rose, eau de fleurs, d'oranges, &c.

Eaux, of the liqueuriste, are aromatised spirits or cordials.

EB'LANINE. The yellowish-red crystallisable, solid substance which is left behind in the retort when wood spirit is rectified from quicklime. It is insoluble in water, and sublimes without fusion at 273° F.

EBONITE. The only difference between this and vulcanite consists in the colouring materials used. See CAOUTCHOUC.

EB'ONY. The wood of the *Diospyrus melanoxylon*, an East Indian tree, of the Nat. Ord. *Ebenaceæ*. Two other species of the same genus, namely, *Diospyrus ebenus* and *D. ebenaster*, yield respectively MAURITIUS EBONY and the BASTARD EBONY of Ceylon. Pale-coloured woods are stained in imitation of ebony (FACTITIOUS EBONY) by washing them with or steeping them in a strong decoction of logwood or of galls, and, when dry, washing them over with a solution of sulphate or acetate of iron. They are then rinsed in clean water, and the process is repeated if required. The wood is lastly polished or varnished.

EBRI'ETY. See INTOXICATION.

EBUL'LIOSCOPE. *Syn.* EBULLITION ALCOHOLOMETER, THERMO-ALCOHOLOMETER. This instrument is essentially a thermometer, and its application to alcoholometry is based upon the fact that the boiling-point of a spirituous liquid is scarcely altered by the presence, within certain limits, of the substances which may be dissolved in it, which, by increasing its specific gravity, render the ordinary alcoholometers or hydrometers useless for the purpose of indicating its alcoholic richness.

The ebullioscope consists essentially of a thermometer having a very minute bore and a large bulb, similar to that employed to determine the height of mountains from the boiling-point of water; but instead of thermometric degrees being marked upon the scale, the percentage under proof is placed on the left-hand side of the stem, and the percentage content of proof spirit on the right-hand side. These commence at 178·5° F., the temperature at which 'proof spirit' boils, and which here forms the bottom of the scale. The succeeding numbers are based upon the boiling-points of mixtures of alcohol and water. The little boiler being charged, and about a teaspoonful of salt (35 gr.) being added to prevent loss of alcohol by evaporation, the thermometer is set in its place, and the spirit-lamp lighted. When the mercury begins to rise out of the bulb of the thermometer, the 'damper-plate' is pushed in a little way to moderate the heat. The eye is now kept steadily on the instrument, and as soon as the liquid boils freely, and the mercury becomes stationary in the stem, the indication is carefully noted, and the damper-plate pushed home to extinguish the flame.

There are several varieties of ebullioscope in use; the chief are those of Tabarié, Malligand and Vidal, and Amagat. Tabarié's instrument consists simply of an upright thermometer, fixed in a small boiler with a spirit-lamp underneath. The ebullioscope of Malligand and Vidal has a separate condenser, and the thermometer is fixed in a horizontal position. The boiler is much smaller than in Tabarié's apparatus, and instead of being heated directly below, the flame is applied to a projecting ring-shaped contrivance. Amagat's ebullioscope is provided with 2 boilers and 2 thermometers, one for the liquor to be tested, and the other for pure water. The thermometers are fixed in a vertical position.

The ebullioscope is adjusted to the mean boiling-

point of water under an atmospheric pressure of 29·5 inches. When the pressure is either higher or lower, both water and alcohol boil at a somewhat different temperature, to meet which a barometrical equation is attached to the thermometer by means of a small subsidiary scale. It is therefore necessary (except with Amagat's instrument, see *above*), before commencing the operation of testing any liquor, to charge the little boiler with pure water only, and to fix the thermometer in its place. When the water boils freely the mercury becomes stationary in the stem, exactly opposite the true barometrical indication at the time. Should this be against the line 29·5 no correction will be required; but should it stand at any other line above or below, then the various boiling-points will bear reference to that boiling-point only. In the latter case the boiling-point of the water on the barometrical indicator must be set against the boiling-point of the liquid on the scale, when opposite the line 29·5 will be found the true strength. Thus, the barometer being at 30 inches, and the indication or boiling-point being 72 u. p., 30 on the indicator must be placed against 72 u. p. on the thermometer, when against the line of 29·5 will be seen 69·6 u. p., the real strength of the sample tested.

When a spirit is stronger than the 'excise proof,' its boiling-point varies too little with its alterations of strength to render the ebullioscope of much practical value. To make it applicable to the stronger spirits it is therefore necessary to dilute them with exactly their own bulk of pure water before testing them, and then to double the resulting indication, as suggested by Dr. Ure.

By means of the ebullioscope the alcoholic content of beer, wines, and spirits, of every variety and class, may be readily determined with sufficient accuracy for all practical purposes.

EBULLI″TION. The state of boiling, or the rapid conversion of a liquid into vapour, taking place not only at the surface (as in evaporation), but in the interior of the liquid. Ebullition occurs in different liquids at very different temperatures, such temperatures being called their 'boiling-points.' Under the same circumstances the boiling-points are constant, and by observing them the chemist is often able to distinguish liquids which much resemble each other. The boiling-point of the same liquid may, however, vary considerably under different circumstances. The causes which induce variation are increased or diminished atmospheric pressure, the greater or less depth of the liquid (causing variation in pressure), the character of the containing vessel, and the presence of air or other gases in solution. Thus water boils at a lower temperature when the barometer is low, in bad weather, or at the top of a hill, than when the barometer is higher, in fine weather, or at the bottom of a valley or mine. There is a very simple and beautiful experiment, illustrative of the effect of diminished pressure in lowering the boiling-point of a liquid. A little water is made to boil for a few minutes in a flask or retort placed over a lamp, until the air has been expelled, and the steam issues freely from the neck. A tightly fitting cork is then inserted, and the lamp at the same moment withdrawn. When the ebullition ceases, it may be renewed at pleasure for a considerable time by sprinkling the flask with cold water, which, by condensing the vapour within, occasions a partial vacuum. Liquids in general boil from 60° to 140° lower than their ordinary boiling-points when heated *in vacuo*.

It is also found that fluids boil at a lower temperature and more quietly in vessels with rough and spicular surfaces than in those with smooth or polished ones. The boiling-point of water, as marked on the scale of the thermometer, is 212° F., but in perfectly clean and smooth glass vessels water free from air may be heated to 221° F. without boiling. That the elevation of the boiling-point in this case is due to the nature of the surface may be at once demonstrated by throwing into water, about to boil in a glass matrass, some iron filings or coarsely powdered glass, when ebullition will commence with almost explosive violence, and at the same time the temperature of the liquid will sink about 2° F.

The boiling-point of water contained in ordinary vessels may be raised considerably above 212° F. by the addition of saline matter, as will be seen in the following table:

TABLE I.—*Boiling-points of Water at Different Pressures* (Regnault).

Boiling-point. °C.	Barometer. Millimetres.	Boiling-point. °C.	Barometer. Millimetres.
0	4·600	100	760·0
5	6·534	105	906·4
10	9·165	110	1075
15	12·70	115	1269
20	17·39	120	1491
25	23·55	125	1744
30	31·55	130	2030
35	41·83	135	2354
40	54·91	140	2718
45	71·39	145	3126
50	91·98	150	3581
55	117·5	155	4089
60	148·8	160	4652
65	186·9	165	5275
70	233·1	170	5962
75	288·5	175	6717
80	354·6	180	7546
85	433·0	185	8453
90	525·4	190	9443
95	633·8	195	10519

TABLE II.—*Boiling-points of Saturated Solutions of Various Salts at the Ordinary Atmospheric Pressure.*

Salt.	Weight of Salt dissolved in 100 parts of Water.	Boiling-point. °C.	Boiling-point. °F.
Acetate of potash	798·2	169	336
Nitrate of calcium	362·2	151	304
Carbonate of potash	205·0	135	275
Acetate of soda	209·0	124·4	251
Nitre	335·1	115·9	246
Sal ammoniac	88·9	114·2	238
Salt	41·2	108·4	227
Carbonate of soda	48·5	104·6	220

In using these solutions as chemical baths it is found inconvenient to employ saturated solutions, as the evaporation of the water produces crystallisation of the salt; they are therefore kept much below the point of saturation.

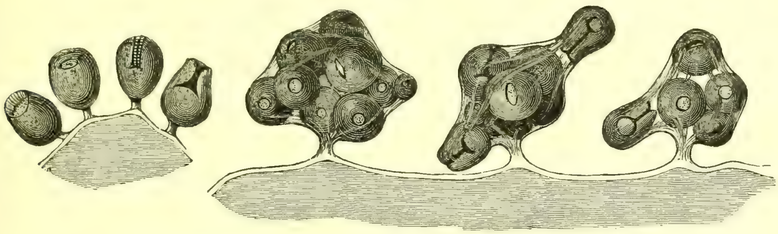
TABLE III.—*Boiling-points of some Interesting Substances.*

Substance.	Boiling-point at Normal Pressure. ° C.	° F.
Nitrous oxide	−87·9	−126·2
Carbon dioxide	−78·2	−108·8
Ammonia	−38·5	− 37·3
Chlorine	−33·6	− 28·5
Sulphur dioxide	−10·08	13·9
Ether	34·97	94·9
Carbon bisulphide	46·20	115·2
Chloroform	60·16	140·3
Methyl alcohol	66·78	152·2
Alcohol	78·26	172·9
Benzene	80·36	176·6
Turpentine	159·15	318·5
Mercury	357·25	675·0
Sulphur	448·00	838·4

ECHINOCOCCUS HOMINIS. This creature, which is the larva of the *Tœnia echinococcus*, is a very common parasite infesting man, and has been found in the human lungs, heart, kidneys, liver, spleen, ovaries, breasts, membrane of the throat, and the bones. The disease to which it gives rise is of a very long and painful nature, frequently terminating fatally, and one in which no remedies have hitherto been found of any avail. The part of the human economy most frequently attacked by the ravages of the Echinococcus is the liver, in the substance of which it gives rise to the formation of a hydatid tumour. This tumour is composed of a thick-walled cyst or bag, within which is another of a much more delicate texture. "This latter membrane is the mother-sac of the Echinococcus embyro" (*Huxley*), and corresponds with the germinal membrane of Professor Goodsir. "It is studded with innumerable transparent cells, varying as extremes of measurement from 1-10,000th to 1-3000th of an inch. It is the seat of development of innumerable Echinococci, and to this membrane, in a fresh hydatid tumour, they are found connected by a delicate membrane, either singly, or more commonly in clusters, the number of individuals on the cluster varying from 10 to 100 or more, as shown in the annexed woodcut" (*Aitken*).

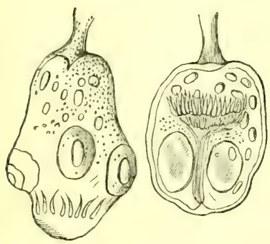
The size of the embyro varies from 1-18th to

FIG. 1.



1-20th of a line to 1-10th to 1-18th, according as it is elongated or contracted. Fig. 2 represents

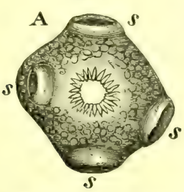
FIG. 2.



two Echinococci. In the one the head is drawn within the vehicle, and in the other it is extruded.

Fig. 3 represents a transverse view of an Echi-

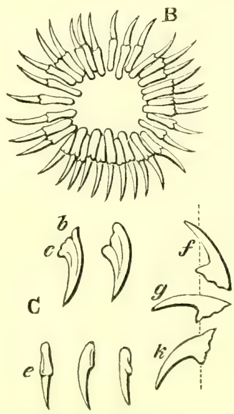
FIG. 3.



nococcus: *s s* are suctorial discs; the hooklets may be seen encircling a membranous disc.

In Fig. 4 we have a representation of the circlet of these hooklets, B, which are 34 in number; C gives various views of separate hooklets; *b* is the

FIG. 4.



base; *c* the central extremity; *e* the hooklets viewed upon their concave or inferior border. The dotted lines connecting *f*, *g*, *k*, represent the outer surface of the neck, and runs through the fixed point of the three hooks which move upon the central fixed process, as on a pivot.

The inhabitants of Iceland are said to suffer severely from the effects of the *Echinococcus*

hominis; it has been computed that 1-6th of the population of the island are attacked by it.

ECLECTIC REMEDIES. These are medicines chiefly employed by a sect of American practitioners, self-styled 'Eclectics.' The medicinal properties appended to each of these preparations are those ascribed to them by the Eclectics themselves. They must not be confounded with true active principles, although the names are often exactly the same, which is likely to lead to serious mistakes. The general process followed for their manufacture is to pour a strong alcoholic tincture of the drug into water, which precipitates the resin; the resin is collected, dried, and powdered.

APOCYNIN. From the roots of *Apocynum* and *Roscemifolium.* Given in jaundice, hepatic torpor, and constipation.—*Dose,* ½ to 2 gr.

ASCLEPEDIN. From *Asclepias tuberosa.* Expectorant, diaphoretic, and tonic.—*Dose,* 1 to 5 gr. 3 times a day.

BAPTISTIN. From wild indigo. Given in liver affections.—*Dose,* ¼ to ½ gr.

BAROSMIN. From *Buchu.* Diuretic, alterative, antispasmodic.—*Dose,* 2 to 4 gr.

CAULOPHYLLIN. From *Caulophyllum thalictroides.* Tonic and alterative, acts on the uterus. —*Dose,* ¼ to 1 gr. 3 times a day; as a parturient, 2 to 4 gr.

CERASEIN. From the *Cerasus virginiana.* Given as a substitute for quinine when the latter is inadmissible.—*Dose,* 5 to 10 gr.

CIMICIFUGIN. *Syn.* MACROTIN. From black snake-root. Tonic, alterative, nervine, antiperiodic, and in chorea.—*Dose,* 1 to 6 gr.

COLINSONIN. From the herb of *Colinsonia canadensis.* Employed in gravel and urinary affections.—*Dose,* 1 to 3 gr.

CORNINE. From *Cornus florida* (dogwood). Antiperiodic.—*Dose,* 10 gr.

EUONYMIA. From the bark of *Euonymus atropurpureus.* A cholagogue and hepatic stimulant. —*Dose,* 1 to 4 gr.

EUPATORINE. From *Eupatorium purpureum.* Diuretic.—*Dose,* 3 to 5 gr.

EUPHORBIN. From *Euphorbia corollata.* Emetic, cathartic, expectorant, and vermifuge.—*Dose,* 1 gr. or less.

GELSEMIN. From *Gelseminum sempervirens.* Given in pneumonia, hysteria, and dysmenorrhœa. —*Dose,* ¼ to 2 gr. This must not be confounded with the powerful alkaloid, Gelsimia.

GERANIN, or GERANIIN. From *Geranium maculatum.* Astringent.—*Dose,* 1 to 5 gr.

HAMAMELIN. From *Hamamelis virginica* (witch hazel). Astringent.—*Dose,* 5 gr.

HYDRASTIN. From *Hydrastis canadensis.* Tonic.—*Dose,* 3 to 5 gr. This must not be confounded with the alkaloid, Hydrasta.

INGLANDIN. From *Butter-nut.* Given in chronic hepatic disorders and constipation.—*Dose,* 2 to 4 gr.

IRIDIN. From the *Blue flag.* Alterative, sialagogue, anthelmintic.—*Dose,* ½ to 5 gr.

JUGLANDIN. From the bark of the root of *Juglans cinerea.* Laxative and cathartic; used in constipation.—*Dose,* 2 to 5 gr.

LEPTANDRIN. From *Leptandra virginica.* Given in liver affections, chronic dysentery, diarrhœa, and typhus.—*Dose,* 2 to 4 gr.

LYCOPIN. From *Lycopus virginicus.* Given in hæmorrhage, diabetes, and dysentery.—*Dose,* 2 to 3 gr.

MYRICIN. From *Myrica cerifera.* Stimulant, astringent, and antispasmodic.—*Dose,* 2 to 10 gr.

POPULIN. From *Populus tremuloides.* Tonic and febrifuge.—*Dose,* 4 to 8 gr.

PRUNIN. From wild cherry bark. Stimulant, tonic, and expectorant.—*Dose,* 1 to 2 gr.

RUMIN. From *Rumex crispus.* Action like rhubarb.—*Dose,* 3 gr.

SANGUINARIN. From *Sanguinaria canadensis.* Hepatic and alterative.—*Dose,* ½ to 2 gr.

SCUTELLARIN. From *Scutellaria lateriflora.* Used as a nervine stimulant in chorea and epilepsy. —*Dose,* 3 to 6 gr.

STILLINGIN. From *Stylingia sylvatica.* Given in bronchitis and laryngitis. Used externally as a stimulant; internally, 1 drop with mucilage.

VIBIRNIN. From *Viburnum opulus.* Antispasmodic; used for relieving cramp.—*Dose,* 1 to 2 gr.

EDIBLE EARTHS. There seems little reason to doubt that the inhabitants of many countries, especially during famine and in times of scarcity, use certain kinds of earth as food. In Spain, a particular kind of earth known as *bucaro* is eaten; the Russian peasant partakes of his *rock-flour;* the Thuringian of his *rock-butter;* the Swede of his *bergmehl* or *mountain meal;* the native of Java of an earth known as *teneampa;* the Hindoo of the so-called *Patna earth;* and the Persian of a species of soil known as *Gheli giveh.*

Mr Molvar has analysed an earth, eaten by the poorer classes of the Neograd district in Hungary, and finds it has the following composition:

Carbonic acid	40·357
Lime	51·488
Magnesia	0·110
Volatile matter	5·545
Ferric oxide	0·158
Alumina	2·272

As the volatile matter seemed to be the probable means of nourishment, it was subjected to a special examination, and was found to contain, besides empyreumatic substances, 0·067 water, and 0·010 nitrogen.

Dr Schmidt, a German chemist, gives the following as the composition of 100 parts of the air-dried powder from the coast of the White Sea:

Water given off at 100° C.	0·260
Given off at a low red heat	0·835
Alumina	40·797
Ferric oxide	0·310
Magnesia	0·618
Lime	traces
Soda	1·829
Potassa	9·845
Silicic acid, trace of fluorine, and loss	45·506

This earth is eaten by the Laplanders, who mix it with the flour of which they make their bread.

The Persian edible earth called *Gheli giveh* contains:

Magnesic carbonate	66·963
Calcic carbonate	23·634
Sodium chloride	3·542
Sodic sulphate	0·293
Sodic carbonate	0·598
Magnesic hydrate	1·311
Ferric oxide	0·092
Alumina	0·227
Silicic acid	0·765
Water combined at 120°	1·153
Hygroscopic moisture	1·422

The 'Chemical News' (xxxvi, 202) contains the analysis by Mr Paterson Muir of a clay from Mackenzie County, South Island, New Zealand, which is largely eaten by sheep. It consists of:

Silica	61·25
Alumina	17·97
Ferric oxide	5·72
Lime	1·91
Magnesia	0·87
Sodium chloride	3·69
Potassium chloride	trace
Water	7·31
Organic matter	1·77
	100·49

EDULCORA'TION. The affusion of water on any substance for the purpose of removing the portion soluble in that fluid. Edulcoration is usually performed by agitating or triturating the article with water, and removing the latter, after subsidence, by decantation or filtration. It is the method commonly adopted to purify precipitates and other powders which are insoluble in water. The washing-bottle is a most useful instrument for the edulcoration of precipitates. In its simplest form, it is a bottle fitted with two bent glass tubes, one drawn to a fine point and reaching to the bottom of the bottle, the other only entering the cork a few inches. By blowing down the latter tube, the water is forced out of the former in a fine stream. See WASH-BOTTLE.

EEL. *Syn.* ANGUILLA, L. A family of fishes belonging to the 'apodal' section of the *Malacopterygii.* At least three species of eels are found in this country—the 'sharp-nosed,' the 'broad-nosed,' and the 'snig.' The first, which is common in streams and lakes, attains the greatest size—sometimes 25 lbs. or even 30 lbs. The 'snig' is considered superior to other kinds for the table. As articles of food, eels are said to be laxative and far from wholesome. The fat (EEL FAT; ADEPS ANGUILLÆ, OLEUM A.) is among the simples of the Ph. L. 1816, and was formerly considered 'good against stripes,' and is even now used by the vulgar as a friction for stiff joints. For the table, eels are generally dressed by stewing, frying, baking, or potting, which is done in the usual way, the fish being cut into pieces 2 or 3 inches long, and melted butter, onions, sweet herbs, and anchovy sauce, added at will. The CONGER EEL is a distinct and gigantic species of the same family. Its flesh is coarse and oily, but is much esteemed by the inhabitants of the southern coast of Devon, on which it abounds.

Letheby states the following to be the composition of the eel:

Nitrogenous matter	9·9
Fat	13·8
Saline matter	1·3
Water	75·0
	100·0

Payen's analysis differs from the above, in giving a larger proportion of nitrogenous matter, and a still greater quantity of fat.

EFFERVES'CENCE. The rapid escape of gas in small bubbles from a liquid. See DRAUGHT POWDER, &c.

EFFLORES'CENCE. The spontaneous conversion of a crystalline solid into a dry pulverulent form. Crystals which in a dry atmosphere lose their water of crystallisation, and become crusted over with a mealy powder, are said to be EFFLORESCENT.

EGG. *Syn.* OVUM, L. A body produced in the females of birds and certain other animals, containing an 'embryo' of the same species, or body, from which a similar animal may ultimately be produced. The eggs of the common domestic fowl are nutritious and easily digestible, and when lightly cooked by boiling and eaten with a little salt, are admirably adapted as an aliment for the sick and delicate. When boiled hard or fried they are rendered less digestible, and possess no advantage in this respect over butcher's meat. A new-laid egg, beaten up in a cup of tea, coffee, or chocolate is an excellent ingredient in the breakfast of a person with a poor appetite, and is very supporting. A glass of wine, beer, or porter, similarly treated, along with a biscuit, has been recommended as a light and nutritious luncheon or supper, well suited to the debilitated and dyspeptic. Raw eggs may be advantageously substituted for cod-liver oil in all the cases in which this last is ordered, occurring in persons with delicate or irritable stomachs. The addition of fresh salad oil vastly increases their medicinal virtues. A fresh egg is said to contain about the same amount of nourishment as $1\frac{1}{2}$ oz. of fresh meat and 1 oz. of wheaten bread, but in a more digestible form.

Composition of the Contents of the Egg.

Water	74·02
Albumen	14·08
Oil and fat	10·25
Mineral matter	1·65
	100·00

Composition of the White of Egg. (*Thompson.*)

Nitrogenous matter	20·40
Fatty matter	0·00
Saline matter	1·60
Water	78·00
	100·00

Composition of the Yelk. (*Thompson.*)

Nitrogenous matter	16·00
Fatty matter	30·70
Saline matter	1·30
Water	52·00
	100·00

The average weight of the new-laid egg of a hen is about $2\frac{1}{4}$ oz., and its sp. gr. is 1·080 to

1·090; the white generally weighs about $1\frac{1}{2}$ oz.; the yelk a little under $\frac{3}{4}$ oz.; and the shell and skin, $\frac{1}{4}$ oz. Dr Prout found that an egg, on being kept for 2 years in a dry situation, lost 544 $\frac{3}{10}$ gr., from the evaporation of a portion of its water through the shell. By boiling in water an egg loses from 2% to 3% of its weight.

Choice. The larger end of a new-laid egg feels cold when placed against the tongue. New-laid eggs appear semi-transparent when placed between the eye and a strong light, and have a small and perceptible division of the skin from the shell, which is filled with air. This mode of examination among the trade is called 'candling.' When they shake they are stale. The eggs of turkeys and peahens are much esteemed for some purposes; those of ducks and geese are coarse and inferior.

Sound eggs will sink if put into a solution consisting of 1 oz. of salt in 10 oz. of water; in the same solution indifferent ones will float, whilst bad or worthless ones will swim even in pure water.

Pres. Eggs may be preserved for any length of time by excluding them from the air. One of the cleanest and easiest methods of doing this is to pack them with the small end downwards in clean dry salt in barrels or tubs, and to place them in a cool and dry situation. We have eaten eggs thus preserved that were more than a twelvemonth old, and that had been for some months on shipboard in a tropical climate, and which yet retained all the peculiar sweetness of new-laid eggs. With a like intention, eggs are placed in vessels containing milk of lime or strong brine, or are rubbed over with butter, lard, or gum water, all of which act by excluding the air. Eggs for keeping should never be laid on their sides, and when kept in the air should be occasionally turned to prevent the yelk attaching itself to the side instead of floating in the albumen. Some persons place the eggs in a netting or on a sieve or colander, and immerse them for an instant in a caldron of boiling water before packing them away. The practice of packing eggs in damp straw, or anything else that can convey a flavour should be carefully avoided. The shells of eggs are porous, and readily admit the passage of gaseous substances, especially of fetid odours. It is from inattention to this point that a large number of the eggs imported from the coast of France have a less delicate flavour than those of our poultry yards. Damp chopped straw, as well as most other organic substances exposed to warmth and moisture, readily ferment or putrefy; and during fermentation a considerable increase of temperature takes place, as any one may readily perceive by examining the common hotbeds in our gardens, which are merely masses of organic matter in a state of decomposition. Eggs, as long as they retain the embryo of the future chick in a vital state, possess in themselves a certain degree of warmth, which tends materially to promote the decomposition of the substances they are packed in, particularly in the presence of moisture.

A correspondent of the 'Chemical News' says: "Eggs may be kept fresh for a whole year by subjecting them to the following process. The fresh eggs are carefully placed in a mixture of 5 kilogrms. of alum dissolved in 5 litres of water, heated to from 45°—50° C., and left in that liquid for from 30 to 40 minutes; the eggs are next drained, and in the meantime the solution of alum is heated to boiling-point. The eggs are again immersed in the liquid and kept therein from 10 to 15 seconds; after having been drained and cooled they are packed in either dry bran, sawdust, cork-dust, sifted ashes, or in cotton-wool."

M. Durand, of Blois, proposes to preserve eggs by coating them with silicate of soda.

To Preserve Eggs fresh for many weeks.—As the eggs are taken from the nest, brush each one separately with a thin solution of gum-arabic, being careful to leave no portion of the shell uncovered by it. The half of each egg must first be done, and left to become dry before the remainder is touched, that the gum may not be rubbed off any part by its coming in contact while wet with the hand as it is held to be varnished, or with the table when it is laid down to harden (*Eliza Acton*).

Eggs, to Boil in the Shell. Eggs brought from a cold place and suddenly plunged into boiling water are very frequently liable to crack, and thus to allow of the partial escape of their contents. In winter it will be found a good plan to hold them for an instant over the steam of the saucepan before they are placed in it, which they should be, very gently. By boiling for 3 minutes, the white will arrive at a partially solid state. Exactly 5 minutes will harden the whites and leave the yelks liquid. Eight or 10 minutes will render them hard. Eggs should always be boiled in water sufficient to entirely cover them. They should be boiled 15 minutes for salad-dressings.

Eggs, to Poach. Take for this purpose a wide and delicately clean pan about half filled with the clearest spring water; throw in a small salt-spoonful of salt, and place it over a fire quite free from smoke. Break some new-laid eggs into separate cups, and do this with care, that the yelks may not be injured. When the water boils, draw back the pan, glide the eggs gently into it and let them stand till the whites appear almost set, which will be in about a minute; then without shaking them move the pan over the fire, and just simmer them from $2\frac{1}{2}$ to 3 minutes. Lift them out separately with a slice, trim quickly off the ragged edges, and serve them upon dressed spinach or upon minced veal, turkey, or chicken; or dish them for an invalid upon delicately toasted bread, sliced thick and free from crust; it is an improvement to have the bread buttered, but it is less wholesome.

Comparative time of poaching eggs: swan's eggs, 5 to 6 minutes (in basin 10 minutes); turkey's eggs, 4 minutes; hen's eggs, 3 to $3\frac{1}{2}$ minutes; Guinea fowl's, 2 to 3 minutes; bantam's, 2 minutes.

Obs. All eggs may be poached *without boiling* if kept just at simmering point, but *one boil* quite at last will assist to detach them from the stewpan, from which they should always be very carefully lifted on what is called a fish or egg slice. There are pans made on purpose for poaching

and frying them in good form; but they do not, we believe, answer particularly well. If broken into cups slightly rubbed with butter and simmered in them, their roundness of shape will be well preserved (*Eliza Acton*).

Egg, Elastic. Take a good and sound egg, place it in strong vinegar, and allow it to remain for 12 hours; it will then become quite soft and elastic. In this state it can be squeezed into a tolerably wide-mouthed bottle; when in, it must be covered with water having a little soda dissolved in it. In a few hours the egg will be restored to nearly its original solidity; after which the liquid may be poured off and the bottle dried, the whole being kept as a curiosity to puzzle one's friends for an explanation how the egg got there ('Parlour Pastime').

Egg Flip. *Prep.* 1. Beer, 1 pint; eggs, 3 in number; sugar, 2 oz.; nutmeg and ginger, q. s. to flavour; the eggs are broken into one half of the beer, the sugar added, and the whole beaten well together; the mixture is then placed in a clean warmer, and heated over the fire to nearly the boiling-point, and stirred one way all the time, care being taken not to let it either boil or curdle; the other portions of the beer and spices are then added, and the whole mixed well together.

2. As above, but adding a glass of spirit. Some persons also add a little lemon peel.

Egg, Glaire of. *Prep.* Separate the whites from the yelks, and whisk them to a froth, let them stand 24 hours, and strain them through muslin. Used as a glaze or varnish by bookbinders and others.

Egg, Liquid. *Prep.* (*Jayne.*) From lime, 1 bushel (slaked with water); common salt, 2 or 3 lbs.; cream of tartar, ½ lb.; water, q. s. to form a mixture strong enough to float an egg. Used to preserve eggs, which it is stated it will do for 2 years, by simply keeping them in it. Simple milk of lime answers quite as well.

Eggs, Packing, for Shipboard. The following plan is now adopted by many firms shipping eggs: "In the bottom of the box may be placed bran, cut hay, and sawdust. Tear up old newspapers to about 8 or 10 inches square. The paper should be about medium—that is, not too stiff nor too soft. Place one of these pieces of paper on the hand, and on this an egg, on one end; close the lower hand so as to bring the paper up all round the egg; with the other hand crumple the loose corners and edges of the paper down over the other end of the egg; lay another piece of paper on the hand, on which place the same egg, but the other end up; bring up the new paper and crumple down as before. This gives a good cushion to both ends, and a fair one over the centre. Repeat this till you have 6 thicknesses of paper, reversing the egg each time, and always keeping it on the end. This gives you a ball about 3 to 3½ in. thick, by 3½ to 4 in. long. Care should be taken not to press the paper too closely to the egg while covering. Place on one end in the box or basket; place alongside and press them together close enough to prevent their becoming loose in the box, filling at the ends and on top with crumpled paper" (*J. P.*).

Egg, White of (ALBUMEN OVI), is officinal in the B. P. Yelk of egg (*vitellus ovi*) is an ingredient in the BRANDY MIXTURE (MISTURA SPIRITUS VINI GALLICI) of the London College. It is also a popular application to chaps, cracked nipples, abrasions, &c., and is largely used to render oleaginous substances miscible with water, in the preparation of emulsions.

Egg Wine. As egg flip, but using equal parts of white wine and water instead of beer.

ELA'IDINE. A fatty compound of elaïdic acid and glycerin, formed by the action of nitrous acid or nitrate of mercury on olive oil. It is neutral; melts at 90° F.; and is very soluble in ether, scarcely so in alcohol. It is one of the components of CITRINE OINTMENT. By saponification it is resolved into its two constituents.

ELA'IN. See OLEIN.

ELAIOM'ETER. *Syn.* OLEOM'ETER. An instrument for ascertaining the specific gravity of oils. See HYDROMETER and OIL.

ELAOP'TENE. See OIL (Volatile).

ELATER LINEATUS, Linn. *Agriotes segetis,* Westwood. The Wireworm. The wireworm, the larva of the *Elater lineatus,* the click beetle, of the Nat. Ord. COLEOPTERA, division *Serricornes,* family *Elateridæ,* is a universal crop destroyer, and may fairly be held to be the first and foremost insect enemy of farmers and gardeners. It is even more injurious to corn-crops of all descriptions as well as to grasses.

There are several species which also feed upon the roots and stems of corn-plants and grasses, among other crops, but the wireworm proper, the arch enemy, the typical destroyer of the race, is the *Elater lineatus,* known also as *Elater segetis* and *Agriotes segetis.* Its larva is larger than that of other species, and is well known to all cultivators as long, yellow, and tough-skinned, almost as tough as wire, from which its familiar name is derived. This insect is known in America, Germany, and indeed in all Continental countries.

Upon light soils it is usually more abundant and destructive, though in some seasons it has been most troublesome in the fens of Lincolnshire and in the clay soils of Essex. In the friable chalk soil in certain districts of Wilts, Dorset, Hants, and East Kent corn and other crops often suffer severely from its ravages.

The attacks of wireworms are always more frequent and serious in districts where clover leys form a part of crop rotation, and especially where these remain down two or more years, also where sainfoin is grown, in which case the land usually remains laid down from 2 to 5 years. It often happens that wheat after sainfoin ley ploughed and pressed in the ordinary manner loses plant disastrously and yields but little corn. To take an instance in East Kent in 1882. Ten acres of land after sainfoin were sown with wheat in October. Even before Christmas, as the weather was mild, it was noticed that the plant was getting thin, and that it got small by degrees and beautifully less, and it was finally reduced to less than half a plant, the other having been eaten by wireworms. After this crop trifolium was taken and cut for horses and cattle. Turnips followed, and were very much damaged by wireworms, so that the farmer estimated his losses upon this field in the 2 years at over £90.

Oat-plants suffer even worse than wheat-plants

because the wireworm works more actively in the spring when oats are sown, so that the plants have less chance to grow away from them. Large bare places may be seen in many oat-fields, particularly in light-land counties, in almost every season, in which upon examination wireworms may be seen at work in numbers. Barley-plants are also very liable to receive injuries from wireworms. Curtis relates that a certain farmer employed boys to pick wireworms from an infested barley-field, and that 18,000 were collected on $1\frac{1}{2}$ acres.

In short, in England, Scotland, and Ireland the wireworm is a continual source of harm to corn-crops of all descriptions. This insect also does much mischief in pasture land and meadows, often undiscovered and unsuspected. The finer grasses especially are chosen, and their stems and root crowns are bored into and eaten away by the wireworms. In the case of newly sown grasses very much and irreparable damage is caused. Failure of grass seeds to take and form pastures in due time is more often occasioned by these larvæ than is dreamed of. Many complaints have been made of mischief to beans. It appears that the wireworms attack these directly the seed has become soft and has commenced to send forth radicles and plumules. The mode of procedure of these wireworms is to fix their heads into the soft parts of the stem just at its junction with the crown, and with their horny jaws to bite away the tissues so that the stem dies, being bitten through and through, or so much bitten that the sap circulation is arrested.

Wireworms are most troublesome in newly formed hop-plantations in England, particularly in those which have been made upon recently broken-up grass land. Planters do not, and very naturally, like to pare and burn the turf or sward with the rich stores of humus; this is therefore ploughed deeply in, and legions of wireworms with it. These being deprived of the roots of the grasses attack the newly planted hop sets, boring into their stems, sucking out the sap, and gnawing off the shoots as fast as they make their appearance, as it would seem in mere wantonness. It frequently happens that the plants die from the attacks, or are only able to put forth weakly and useless shoots. Sometimes wireworms do indefinite mischief in established plantations, causing injuries which are frequently attributed to natural decay, or to the soil or subsoil, as the insects bury themselves into the stocks, and are not easily discovered. This cannot be said to be a new foe to hop-planters by any means. Lance speaks of it, though he confounds wireworms with centipedes. Curtis also alludes to it as injuring hop-plants. But without doubt it has been very much more abundant during the last 5 years, and its ravages have been unusually great in various places in all the hop-producing districts.

Life History. The perfect insect, or beetle, is of a tawny brown colour, having stripes or lines upon the elytra or wing-cases. The body has also lines upon it. In this state it is believed that the beetles do no harm to crops. They may be seen in May flying, especially in damp places, and resting upon weeds and plants. Towards the end of June pairing takes place, and the females, helped by their long narrow shape, place their nearly round, minute, white eggs on the stems of grasses, weeds, and the stalks of corn-plants, close to the ground, as Curtis says, between the enveloping leaves or sheaths near the bases of the stalks. From the eggs larvæ are produced of very small size, which grow slowly, and finally attain a length of about an inch. They are yellowish, having 6 thoracic legs, with their bodies divided into 12 segments, looking like coats of mail or the plates of an ironclad under the microscope. There are dark-coloured marks upon the terminal segment, characteristic of this species according to Westwood. The mandibles or jaws of the larvæ are perfectly adapted for gnawing roots and stems. Curtis states that these jaws are sometimes so worn at an advanced age that the apex is rounded, and the smaller teeth have entirely disappeared.

The larvæ remain in the ground, devouring what root, or stem, or bulb food may come in their way, for several years. Five years is the extreme limit, according to some entomologists; others say more.

Before assuming the pupa state the wireworms go down deep into the earth for their transformation, which is accomplished in about a fortnight, and the perfect insects come from the ground. There is no cocoon enwrapping the pupa. Taschenberg is of opinion that some of the pupæ may remain *in statu quo* during the winter; but Bjerkander, the great authority upon these insects, does not support this—neither does Curtis.

Prevention. First and foremost among means of prevention is the abolition of weeds from the land and from the outsides of fields. This has been recognised and adopted long ago by some agriculturists, for we find the following passage in vol. xv of the 'Journal of the Royal Agricultural Society of England,' in an essay upon the farming of light land, which is always more liable to attacks of wireworm:—"There is a farm in the neighbourhood of Guildford which presents an instance of a perfectly clean farm, and kept so by deep ploughing, unsparing use of horse and hand hoes. It has often been remarked that root-crops and corn are unmolested by wireworms upon this farm. The owner asserts that he starved them long ago by growing no weeds to sustain them in the absence of a crop."

The habits of this insect do not take it far from its birthplace. It evidently prefers in its perfect state to crawl or climb on plants and weeds, and it may be constantly seen in the summer crawling on the ground in meadows and leys, and the duration of its life in this stage is most limited. In districts subject to wireworm clover leys should not be kept down 2 years. After the first cut of clover or 'seeds' sheep should be put on and the herbage kept closely fed down until the autumn. Sainfoin should be omitted from the rotations in these circumstances until the wireworms have been starved out.

Following a bad attack in wheat, oat, and barley crops in which damage is plain and manifest (whereas in turnip and other bulb crops and grass it is by no means so apparent, and the presence of wireworms often passes undetected) a winter fallow is strongly recommended. It is highly important that the land should be

scarified or cultivated immediately after harvest and kept moved as long as the weather will allow, that no roots or stems may be permitted to live. As soon as it is possible in the spring the soil should be again stirred and weed growth stopped. Tares may be sown then. Wireworms do not attack this crop for some reason. If there are doubts as to whether the enemies have been starved out a crop of mustard should be taken, either for folding off or for soiling. Wireworms cannot eat these plants, and if plenty of seed is put on, so that there may be a thick plant, all weed and other growth is completely checked.

For oats after wheat on fields suspected of harbouring wireworms thorough cultivation immediately after the wheat has been carried, and a rigid destruction of all growth in the soil would be efficacious in at least reducing the numbers of the destroyers. When barley is taken after wheat this course would be more likely to be effectual, since this grain may be sown in most districts much later than oats. It would be better still to put peas in after the wheat, late and after thorough cultivation, as wireworms, as at present believed, do much injury to this crop. But if the land is foul and full of water grass, couch, and other weeds, it would pay over and over again to give it a summer fallow with continual scarifying and cleaning.

Prevention in Hop-plantations. In old hop-plantations it is somewhat difficult to prevent the attacks of the click beetle, especially in small fields and those surrounded with woods and hedgerows. Where hop-plantations are in masses the injury from this source is usually comparatively inconsiderable. It is most desirable to keep the land clear from weeds upon which the insect might deposit eggs; also the outsides well cleaned and closely brushed and free from grass and nettles. This weed is, it should be stated, very attractive to many insects hurtful to hop-plants, and should therefore be studiously eliminated from their neighbourhood.

Caustic substances dug in round the plant-centres will prevent, or, at all events, retard an attack from outside or below, but will not prevent the action of wireworms generated close to and upon the plant-centres. Opening a trench in the autumn, after the poles are down, and forming a ring close round the plant-centres, and putting in earth, ashes, or sawdust saturated with paraffin oil is an excellent plan in the case of plantations that are badly infested. Hard frosts do not affect wireworms, since they go down into the earth to a depth of nearly 15 inches.

Before planting pasture land or meadow land with hop-plants it is most necessary that it should be kept well fed down by sheep up to the time of ploughing in the autumn. With regard to arable land taken for hop-plantation, this should be freed from weeds during the summer. A crop of white mustard might be taken with much advantage before planting, as the wireworms cannot live in this, and would be starved out.

Planters who suspect the presence of wireworms very frequently set a row of potatoes between the rows of hop-plants in order to draw the wireworms from the young hop-plants.

Birds should be encouraged in infested
Rooks devour quantities of these insects.
sants, partridges, and many small bird
greedily eat them. Moles are especially d
to them. Instead of every farming man
farming boy's hand being set against
instigated thereto by a reward of 2*d.* pe
farmers, and hop-planters in particular,
rather encourage their increase. In the
States the State entomologists recommend th
tection of the disagreeable skunk on acco
the service it renders to the hop-planter b
covering and destroying the grub of the
moth, which attacks the roots of the hop-
and many other insects upon which it feeds
barbarous traps for killing moles should b
hibited, and when it might be necessary to
moles, in gardens and where small and d
plants are cultivated, traps might be ma
catching them alive and transporting th
insect-affected spots. Special traps, 'mole
are made in Gloucestershire for catching
alive. These are earthen jars, which are l
the ground, level with the runs of the
They fall into these and cannot get out, an
be taken out alive.

In a young hop-plantation potatoes were
tween the rows of plants. Upon hoeing th
toes, it was found that moles had made a s
ranean gallery up almost every row of pota
search of their favourite food.

Remedies. If wheat-plants show signs o
worm attack soon after they are up in Nov
from 40 to 50 bushels of soot should be
per acre, or 7 or 8 cwts. of gas lime. The
other applications of the same nature ofte
to dislodge the wireworms and keep them
from the plants, as they feed just unde
ground in the slightly bulbed bases of the
a little above the crown of the roots. A
nitrate of soda might be put on advantag
to stimulate the plants. In the winter,
the season is mild, the wireworms do not t
the wheat-plants, but they commence oper
again upon the first indications of spring. Di
therefore, the land can be got upon it sho
well rolled down with plain and ring roll
compress the soil tightly round the plants. N
of soda, or sulphate of ammonia, or guano
be applied at this time to force the plants
quickly. Treading light 'hover' wheat
with sheep is useful occasionally, and ber
to the plants in some circumstances. It i
posed that treading and rolling the land ki
wireworms, but this is a mistake, for thes
cesses merely press the earth down firmly
to the plants, thereby hindering the move
of the insects; these are much too tough
killed in this way.

When oats and barley are attacked the
should be well rolled, and dressings of stimu
manures put on before the rollings. Cr
these grains have been saved by broadc
from 6 to 8 cwts. of ground rape cake upon
Wireworms are particularly fond of this, a
takes their attention entirely from the p
which, in the meantime, can grow away from
It was commonly believed formerly that rap
killed the wireworms in some mysterious m

but this is a complete delusion. If the ground be searched after such dressings of rape cake it will be found that the pieces are full of wire-worms. Rape cake, however, should only be applied when other remedial measures have failed, and when it is necessary to attract the wireworms from the plants, for there is no doubt that the ultimate effect of rape cake is to greatly encourage the insects, as in the case of hop land.

When land is laid down with grass, if there is any suspicion that wireworms are present, it is most desirable to sow rape with the grass seeds to employ the wireworms until the young grasses have got away from them in some degree. In this case spring sowing is best. When newly sown grass-plants are getting thin from the attacks of wireworms, rape cake must be put on at once.

In meadow land beset with wireworms heavy and constant rollings are essential, with dressings of 5 or 6 cwts. of salt, or of from 14 to 20 cwts. of gas-lime, or 50 to 70 bushels of soot per acre. Liquid manure is also effectual in keeping them off, if plentifully used, and folding sheep.

The natural enemies of the wireworm are fortunately many. Rooks search for and devour them greedily. Their practised eyes note the 'worm i' the bud,' and they quickly detect the ailing plant and extract the cause of the evil. No doubt they pull up plants of corn in their search, but in all probability the plants they pull up would have died, and the wireworms are prevented from doing further mischief. It is believed that rooks do incalculable good; they should on no account be driven from corn or other cropped fields, except when the corn is sprouting, and when it is ripening. Starlings do infinite good in meadow land. Plovers, peewits, gulls, and jays also eat wireworms with avidity.

Remedies in Hop-plantations. When wireworms have once become settled in a hop-plantation it is a most difficult matter to dislodge them. They have a stronghold in and around the plant-centres, in which they ensconce themselves, and they cannot easily be got at. Nitrate of soda, guano, lime, soot, and other manures of a caustic nature have been put as near the plants as it would be safe to put them, and in most cases without much success. The wireworms work upon and in the young shoots, to which it would be most injurious to apply substances that would affect the insects.

It is almost impossible to move them from their position by cultivation. They are frequently moved, at all events temporarily from wheat, oat, and turnip-plants by heavy rolling and harrowing, but it will be seen that such remedies cannot be applied in hop-plantations. Digging or prong-hoeing round the plants might be advantageous, though the grubs actually upon them could not be directly reached.

In young hop-plantations of the first year it has been found practicable and efficacious to make a ring very close round the plants with the little short hoe used for covering in after dressing, and to sprinkle earth, ashes, or sawdust saturated with paraffin oil in these, taking care not to put too much oil, so as to kill the shoots. Planters will see that this cannot be so easily done in the first year of poling and afterwards; still, with care and contrivance it might be managed, even when the full complement of poles is set up. But the best and most sure means of dealing with wireworms when at work upon hop-plants is to put baits near them, 2 or 3 inches below the ground, in the shape of pieces of mangel-wurzel, turnip, carrot, potato, or rape cake. These should be taken up once a week at least, and wireworms, attracted by the more pleasant food from the hop-plants, will be found embedded in them, and may be taken out and destroyed. As many as 150 wireworms have been caught in this way near one plant-centre. Continental and American entomologists and planters highly commend this method.

Dressings of rape dust dug in round infested plants will also draw the wireworms, relieving them for a time, but also tending to collect the wireworms round or near the plant-centres. Rape dust is employed as a manure for hop-plants in enormous quantities, and this without doubt has caused the increase of wireworms in hop-plantations, as they are particularly fond of it. The common notion that rape dust is a remedy against wireworms, because they eat so greedily of it that they burst their skins, is without any foundation at all.

ELAT'ERIN. *Syn.* MOMORDICINE. The active principle of ELATERIUM. It was discovered by Dr Clutterbuck in 1819, but first obtained in a state of purity in 1830 by the late Mr Hennel.

Elaterin. *Syn.* ELATERINUM (*Dr Morries*). Obtained by evaporating tincture of elaterium (made with rectified spirit) to the consistence of thin oil, and throwing it in boiling distilled water. When cold the crystalline precipitate is collected and dried with a gentle heat.—*Dose.* To commence with, $\frac{1}{16}$ gr.

Prep. 1. (*Dr Morries.*) Elaterium is digested in hot alcohol, the resulting tincture filtered, evaporated to the consistence of thin oil, and then thrown into boiling distilled water. When the whole is cold, the precipitate is collected and purified by redissolving it in alcohol and precipitation by water, as before.

2. (*Hennel.*) The alcoholic extract of elaterium is digested in ether, and the residuum dissolved in hot alcohol; crystals form as the solution cools.

3. An alcoholic tincture is evaporated to the consistence of a syrup, and thrown into a mixture of equal parts of liquor of potassa and water at a boiling temperature. Almost pure elaterin separates as the liquid cools.

4. (B. P.) Elaterium is exhausted with chloroform, and to the solution ether is added, which precipitates the elaterin. The precipitate is re-crystallised from chloroform.

Obs. Elaterin forms delicate, white, silky crystals, having a bitter taste; it is fusible at about 365° F.; tastes bitter; odourless; neutral; insoluble in water; and dissolves readily in hot alcohol. With melted carbolic acid it yields a solution which, on the addition of sulphuric acid, gives a crimson colour. Its medicinal action is similar to that of elaterium, differing only in its greater activity.—*Dose,* $\frac{1}{16}$ gr. to $\frac{1}{20}$ gr.

ELATE'RIUM. *Syn.* SQUIRTING CUCUMBER. In *pharmacy*, 'the fresh unripe fruit' of the wild cucumber, '*Ecbalium elaterium,* Richard,' Ph. L. (*Momordica elaterium,* Linn.). According to present usage, the word is more generally applied to the feculence deposited from the juice of the wild cucumber. It is thus applied in Ph. B. E. & D. (see *below*).

Elaterium. B. P. *Syn.* EXTRACT OF ELATERIUM, E. OF SQUIRTING CUCUMBER; EXTRACTUM ELATERII (Ph. L.), ELATERIUM (Ph. E. & D.), L. The feculence of the juice of the above fruit.

Prep. 1. (Ph. L.) Slice wild cucumber before it is quite ripe in the long direction, and strain the juice, very gently expressed, through a fine hair sieve; then set it aside for some hours, until the thicker part has subsided. The thinner supernatant fluid being rejected, dry the thicker portion with a gentle heat. The processes of the other colleges are essentially the same. At the Mitcham Gardens elaterium is manufactured in much the same way, only that considerable force is used in the expression of the juice, and the product therefore less potent, though more in quantity. The manufacture usually commences about the second week in September (*Dr Royle*).

2. (*Dr Clutterbuck.*) The cucumbers (fully ripe) are cut longitudinally and sprinkled with cold water, and the juice allowed to strain through a fine sieve into an earthenware vessel. The seeds and surrounding pulp are next placed on the sieve with the split fruit, and washed repeatedly with cold water. The washings being received in the same vessel with the juice, the whole is allowed to repose for a few hours, when the clear portion is decanted and the sediment spread thinly on fine linen, and dried by exposure to the air and a gentle heat, avoiding the sunshine or a bright light. Quality very fine. Forty fruits, by this process, yield only 6 gr. of elaterium.

3. (Apothecaries' Hall.) The fruit, slit into halves, is placed in hempen or horsehair bags, and submitted to slight pressure in a tincture press. The juice, as it runs off, passes through a fine hair sieve into a cylindrical glass jug or jar, where it is allowed to remain for 2 hours, when the clear supernatant liquor is poured off, and the thick portion containing the sediment is poured on a paper filter, supported on linen, and allowed to drain, after which it is dried by a gentle heat in a stove. The product has a green colour, and constitutes the finest elaterium of commerce. A darker and inferior article is obtained from the liquor, poured from the first sediment by placing it in shallow pans, and allowing it again to deposit.

Prop., &c. Elaterium is sold in thin cakes, and when pure has a pale-grey or greenish-grey colour, floats on water, is easily pulverised by pressure, and forms with rectified spirits a pale green-coloured tincture. Elaterium obtained as a second deposit (ELATERIUM NIGRUM) is dark and inferior. Alcohol dissolves from 50% to 60% of good elaterium. "When exhausted by rectified spirit, the solution, concentrated and poured into hot dilute solution of potassa, deposits, on cooling, minute silky, colourless crystals (of ELATERIN), weighing from 1-7th to 1-4th of the elaterium operated on" (Ph. E.).

Obs. To procure a fine sample of elaterium it is necessary to remove it as soon as it is deposited, as a heavy mucilage falls down soon afterwards, which materially injures its quality and appearance. English elaterium is the best. The foreign is uniformly adulterated with chalk or starch, and coloured with sap green.

Dose, $\frac{1}{16}$ gr. to $\frac{1}{2}$ gr., formed into a pill with extract of gentian and liquorice powder; as a hydragogue and cathartic in dropsies, twice a day, repeated every other day for a week or ten days. Its use must be avoided when there is much debility or any inflammatory symptoms. Larger doses than $\frac{1}{2}$ gr. of pure elaterium are poisonous. The *antidotes* are emetics, followed by demulcents, opium, and stimulants.

EL'DER. *Syn.* SAMBUCUS (Ph. L. and E.), L. A large shrub or small tree belonging to the Nat. Ord. CAPRIFOLIACEÆ. It is indigenous in Europe, and has long been valued for its medicinal properties. 'The recent flowers of the *Sambucus nigra*' (Ph. L.), or common elder, are regarded as diaphoretic and pectoral, and a distilled water (ELDER-FLOWER WATER; AQUA SAMBUCI) is made of them. The inner bark of the same tree is purgative and emetic, and is used in dropsy; the leaves are purgative; the juice of the fresh berries is made into wine (ELDER WINE), and is largely used to make FACTITIOUS PORT WINE and to adulterate the real wine. See WATERS (Distilled).

ELECAMPANE. *Syn.* INULA (Ph. L.), L. 'The root of *Inula helenium*' (Ph. L.). A plant of the Nat. Ord. COMPOSITÆ. Tonic, diaphoretic, and expectorant.—*Dose,* 20 gr. to 1 dr., or more, either in the form of powder or decoction; in catarrh, dyspepsia, &c. It is now seldom used.

ELEC'TRIC. *Syn.* ELECTRICAL. Exhibiting the effects of ELECTRICITY when 'excited' by friction; pertaining to, derived from, or produced by electricity.

Electric. *Syn.* INSULATOR, NON-CONDUCTOR. A substance which may under ordinary circumstances be readily made to evince electrical properties by friction. Electrics do not transmit or conduct electricity; whilst, on the other hand, ANELECTRICS are good transmitters or conductors of electrical action. The most perfect electrics are shell-lac, sulphur, amber, jet, resinous bodies, gums, gun-cotton, glass, silk, diamond, agate, and tourmaline; dry fur, hair, wood, feathers, and paper; turpentine and various oils; dry atmospheric air, and other gases, steam of high elasticity, and ice at 0° F. The most perfect anelectrics or conductors are the metals, charcoal, and saline fluids.

Electric Eel. The *Gymnotus electricus,* a fish having the power of giving violent electric 'shocks,' which power it exerts for killing or stunning its prey. It is an inhabitant of the fresh-water lakes and rivers of the warmer regions of America, Africa, and Asia.

Electrical Machine. An instrument for the excitation and collection of electricity. The term is only applied to contrivances in which friction is the immediate cause of the electrical disturbance; those which act through chemical force, magnetism, or heat being known by various distinctive names, as 'voltaic battery,' 'electro-

magnetic machine,' 'induction-coil,' 'thermo-electric pile,' &c.

The electrical machines in common use are composed of a hollow glass cylinder, or circular plate of glass, turning on an axis, and rubbing against two or more leather rubbers covered with silk, the electricity being collected by sharp points fixed in a metal rod standing on a glass pillar. A description of these instruments, however, would be out of place in the present work, which does not aim at giving information that may be easily obtained from other sources.

Cylinder machines are seldom made of greater size than 13 inches by 9, and are about as powerful as an 18-inch plate machine. The latter are commonly made up to 3 and 4 feet diameter, and will, with a suitable condenser, give 15-inch sparks in air.

ELECTRI″CITY (-tris′-it-e). The name given primarily to one of the great forces of nature, and secondarily to that department of physical science which embraces all that is known respecting this particular force. Many theories respecting the nature of electricity have been advanced for the purpose of explaining electrical phenomena. The theory of Dr Franklin supposed the existence of a single homogeneous, imponderable fluid, of extreme tenuity and elasticity, in a state of equable distribution throughout the material world. This fluid is assumed to be repulsive of its own particles, but attractive of all other matter. When distributed in bodies, in quantities proportionate to their capacities or attraction for it, such bodies are said to be in their 'natural state.' When we increase or diminish the natural quantity of electricity in any substance, excitation is the result, and the substance, if 'overcharged,' is said to be electrified 'positively;' or if 'undercharged,' 'negatively.' These theories, and all others based upon the assumption that electricity is a form of matter, have been found to be inadequate for the elucidation of electrical phenomena.

An explanation of modern views as to the nature of electricity would lead us far beyond the scope and object of this work, and the reader is advised to consult some of the most recent text-books on the subject.

Electricity, Iron reduced by. Gelatin capsules of the size of a 2-gr. pill, filled with powdered blacksmith's scobs (black oxide of iron) (*Hager*).

ELECTRO-CHEM′ISTRY. That branch of chemistry which treats of the agency of electricity in effecting chemical changes.

ELECTRO-ETCH′ING. See ETCHING.

ELECTROLYSIS (-trŏl′-e-sis). The decomposition of a chemical compound by the passage through it of an electric current. The substance decomposed is called an *electrolyte*, and must be in the liquid state. The extremities of the conductors through which the electric current enters and leaves the liquid are called *electrodes*. The electrolyte is gradually separated into two constituents (either elements or radicles), which travel in opposite directions in the liquid, one following the direction of the positive electricity, the other that of the negative; they appear in the free state at the electrodes, and the separation goes on continuously as long as the current is kept up.

Those elements or radicles which follow the direction of the positive current, and are cooled at the negative electrode, are called electro-positive bodies; such are hydrogen, the metals, and basic radicles in general. Those which travel in the direction of the negative current, and appear at the positive electrode, are called electro-negative bodies; such are oxygen, chlorine, and radicles in general. Faraday called the surface of the electrolyte in contact with the positive electrode, the *anode;* and that in contact with the negative electrode, the *cathode;* he also applied the terms *anions* and *cations* to the elements evolved at the anode and cathode respectively, and included both sets of elements under the general term *ions*. These terms are, however, not much used.

Examples of Electrolysis. Water (made slightly acid) is easily decomposed by the current from 3 or 4 Grove's cells; the gases evolved may be collected by inverting cylinders full of water over the electrodes, which should be of platinum. Hydrogen will be evolved at the negative electrode, and oxygen at the positive, and the volume of the hydrogen will be twice that of the oxygen. The strength of the current may be measured by the volume of gas produced in a given time; this is the principle of an instrument called a *voltameter;* the gases may be collected together, or separately; it is more accurate to measure the hydrogen only, as it is less soluble in water than oxygen.

Hydrochloric acid, on electrolysis, gives hydrogen at the negative, and chlorine at the positive electrode.

Copper sulphate in solution gives metallic copper at the negative, and sulphuric acid at the positive electrode.

Potassium iodide in solution yields iodine at the positive, and potassium at the negative electrode; the potassium liberated, however, immediately decomposes the water, so that hydrogen is evolved, and a solution of potash is formed.

Fused iodide of lead yields iodine at the positive, and lead at the negative electrode.

Laws of Electrolysis. These were discovered by Faraday, and may be briefly summed up thus: When the same current passes successively through different electrolytes, the quantities of these compounds decomposed and of the several elements liberated, are chemically equivalent to each other. Suppose the same current to traverse successively water, copper sulphate solution, stannous chloride (solution, or fused), and silver nitrate solution, then for every grm. of hydrogen set free there will be liberated 31·5 grms. of copper, 59 of tin, and 108 of silver; these numbers being the equivalents of 1 grm. of hydrogen.

Practical Applications. These are numerous, the chief being electro-plating (*see* ELECTROTYPE). Some of the metals may also be conveniently obtained by electrolysis of their fused chlorides, *e. g.* barium, strontium, lithium, magnesium, aluminium. Magnesium may be easily obtained by electrolysing a mixture of fused chloride of magnesium, potassium, and ammonium in a tobacco-pipe, the negative electrode being formed of an iron wire passed up the pipe-stem, and the positive of a piece of gas-coke, just touching the surface of the fused chlorides.

ELECTROPH'ORUS. A simple instrument for exciting electricity, sometimes used in the chemical laboratory for charging small Leyden jars, when gases have to be exploded by the electric spark. To construct it, a plate of tinned iron is made into a circle of about 12 inches diameter; a raised border is then turned up for about ½ an inch, and the extreme edge is turned outwards over a wire to avoid a sharp border. A mixture of equal parts by weight of shell-lac, Venice turpentine, and resin is made by gently heating them together with stirring until they are well fused and thoroughly incorporated. This composition is poured into the plate, so as to quite fill it, and is kept melted until all bubbles have disappeared. Another portion of the instrument, serving the same purpose as the conductor of an electric machine, is a circle of wood rather smaller than the resinous plate, rounded at the edge, and neatly covered with tin-foil; a metal plate will do equally well. An insulating handle, formed of a piece of stout glass rod, is cemented into the centre of this wooden disc. Before using the instrument it must be carefully dried and slightly warmed. The resinous surface is excited by beating it obliquely with a folded piece of warm flannel. When this has been done for about a minute, the warm dry cover of the instrument is placed upon the resinous plate, and touched with the finger. If the cover is then raised a few inches and the knuckle approached, a powerful spark of positive electricity will pass; and if the cover be again replaced, touched, and raised, a second spark will pass. This may be repeated many times without again exciting the resinous plate. By receiving the sparks with the knobs of a Leyden jar, a charge strong enough to give a powerful shock or explode a gaseous mixture, may be rapidly obtained.

The action of the instrument may be briefly explained thus:—On beating the resinous composition with flannel, it becomes negatively electrified; when the cover is placed upon the composition, the negative electricity of the latter induces a positive charge on the lower surface of the former, while the negative electricity of the cover is driven to the upper surface, and escapes to the earth when the cover is touched with the finger. There is thus a 'bound charge' on the lower surface of the cover, which becomes a free charge of positive electricity on removing the finger and lifting the cover. The cover may be discharged, and the process repeated many times.

ELECTRO-PLA''TING and GILDING. See ELECTROTYPE.

ELECTROTYPE. *Syn.* ELECTRO-MET'ALLURGY, GALVAN'O-PLAS'TIC. The art of working in metals by the aid of electricity. Strictly speaking, the term electrotype is only applicable to one branch of 'electro-metallurgy'—that which relates to the production of copies of engraved plates, medals, coins, and other works—but it is now commonly employed in the sense indicated by our definition. According to this extended signification of the term, the art of electrotype includes ELECTRO-PLATING and ELECTRO-GILDING.

General Principles. If a current from a voltaic battery be passed, by means of platinum electrodes, through water to which some sulphuric acid has been added, electrolysis takes place, hydrogen appearing at the cathode and oxygen at the anode. If into the acid liquid some crystals of sulphate of copper be now thrown electrolysis will still go on, but only one of the elements of the water, namely, oxygen, will be evolved, being produced probably in this way: The copper sulphate $CuSO_4$ is split into Cu and SO_4, and the SO_4 unites with hydrogen of the water, forming sulphuric acid H_2SO_4, and liberating the oxygen, while the copper thus liberated will be deposited on the platinum plate or wire which constitutes the negative electrode. This experiment may be continued until all the copper is extracted from the solution. Let this experiment be repeated with a copper plate for the positive electrode, and it will be found that neither of the gases will be evolved. The oxygen, instead of escaping at the anode, will combine with the copper of the electrode and the sulphuric acid to form sulphate of copper. The chemical forces called into action by the current are so beautifully balanced, that in the last experiment the quantity of copper supplied by the positive electrode exactly equals the quantity withdrawn from the solution and deposited upon the negative electrode. The whole art of electrotype consists in applying the metals thus released from their solutions to artistic or useful purposes. To obtain compact and brilliant deposits, many precautions have to be observed. The solutions must be kept saturated, or nearly so; the mould to be copied or object to be coated must not be too small, or out of proportion to the size of the zinc plate of the battery; in fine, the power employed must be carefully regulated according to the work to be done. In all arrangements the moulds or objects which receive the deposits act as negative electrodes, and are consequently in connection with the zinc of the battery or generating cell.

Electrotype Processes. Regular deposits of many metals can be obtained through the agency of voltaic electricity; we shall treat of those of copper, silver, gold, platinum, nickel, zinc, tin, and iron. When copper is deposited, the object is generally to produce a substantial copy of a medal, an engraved plate, or other work of art; but when solutions containing the precious metals are electrolysed, the deposits are nearly always used for covering the surface of inferior metals. We shall notice the operations connected with the deposition of copper and those relating to electro-plating under separate heads.

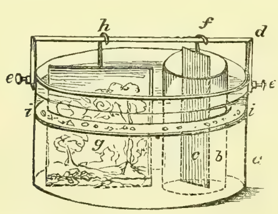
I. DEPOSITION OF COPPER:

The moulds or models intended to receive the deposited metals may be formed of various materials. For medals and similar small works, moulds of fusible metal, white wax, stearine, stearic acid, and gutta percha are commonly used. The first are formed by dropping or pressing the medals to be copied upon the melted metal, taking care that the former are quite cold, and that the surface of the metal is bright or free from oxide. To make a mould in gutta percha, the material must be softened in warm water, and then pressed upon the medal by means of a strong screw press. With the other materials the manipulation is very easy. A ribbon of cardboard or thick paper is placed round the medal, so as to form a rim; the

material, which has been melted in an earthen vessel, is then poured on and allowed to remain until quite cold and hard, when it is cautiously removed. For large works, moulds of plaster of Paris are usually employed; these require to be saturated with wax or tallow by standing them in a shallow vessel containing these substances in a melted state. For copying seals and small coins, impressions in ordinary sealing-wax may be used as electrotype moulds. Non-metallic moulds must be coated with some substance which has the property of conducting electricity before they can be used as negative electrodes. The substance commonly employed is plumbago or black-lead. It must be in the condition of an impalpable powder, and is rubbed briskly over the surface of the mould (wax, stearine, plaster, &c.) by means of a strong fine camel-hair brush, till the whole presents the well-known black-lead polish. The adhesion of the plumbago may be often promoted by breathing slightly on the mould. To cause it to adhere to sealing-wax impressions, the wax may be slightly moistened with spirits of wine, or exposed to the vapour of ether. Delicate moulds, and objects which cannot well be black-leaded, may be covered with a conducting film of silver, by first dipping them in bisulphide of carbon holding about 1-20th part of phosphorus in solution, and then, after a few seconds, immersing them in a weak solution of nitrate of silver, and allowing them to dry in the light. Metallic moulds require no preparation except cleaning.

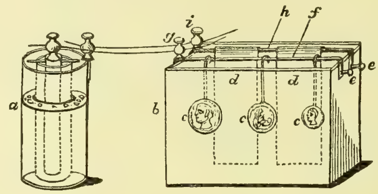
The voltaic apparatus used may now be described. The single-cell arrangement, used for small works, is formed on the principle of Daniell's Constant Battery. It consists of a vessel of glass or earthenware, containing a smaller cell of thin biscuit ware or other porous material; a rod or plate of amalgamated zinc placed within the porous cell, and a wire connecting the zinc with the mould to be copied; the latter being placed in the outer vessel. The annexed figure represents a convenient form of the single-cell:

The battery arrangement has many advantages over that described above, and should always be employed when large objects are to be electrotyped, or when a number of small moulds are to



a. An oval vessel of salt-glazed earthenware, nearly filled with a saturated solution of sulphate of copper.
b. A porous diaphragm, containing the cylinder or plate of zinc (*c*), and filled with dilute sulphuric acid.
d. A small bar of brass or copper fastened to the vessel by the binding screws (*e, e*), and supporting the plate of zinc (*c*) by the hook of copper wire (*f*), and the mould (*g*) by the hook (*h*).
i. A small shelf or partition to support crystals of sulphate of copper, to keep up the strength of the solution.

be operated upon. In this arrangement the copper solution is electrolysed in a separate vessel, termed the decomposition cell, and the current generated by one or more cells of a Daniell's or Smee's battery. This arrangement is shown in the following engraving:



a. A constant battery cell.
b. Decomposition cell, a cubical vessel made of earthenware, and filled with a mixture of 1 part of dilute sulphuric acid (1 acid + 9 water), and 2 parts of saturated solution of sulphate of copper by measure.
c, c, c. Moulds suspended to the brass rod (*f*), and connected with the zinc or positive element of the battery (*a*) by means of the screw (*g*).
d, d. Pieces of sheet copper suspended on the brass rod (*h*), and connected with the zinc end of the battery by means of the screw (*i*), employed to keep up the strength of the copper solution in the decomposition cell.

To connect the moulds with the zinc or positive element, stout copper wires or strips of thin sheet copper are employed. In the case of a non-metallic mould, the wire must lead directly to the plumbagoed surface, or, what amounts to the same thing, the plumbago must be extended to the point of attachment. The connecting wires and the backs and edges of metallic moulds, must be covered with sealing-wax varnish or other non-conducting substance, to prevent them receiving the deposit. Before a mould is placed in the copper solution it is advisable that everything should be arranged so that the immersion may occasion immediate voltaic action. If the connection between the zinc and the mould is not effected until after the immersion, the solution may act chemically upon the surface of the mould, and cause the deposit to appear dark and dirty. When a mould has remained in the solution long enough to receive a complete coating of copper, it may be lifted out with impunity for examination. If everything is going on well, the deposited metal will present a brilliant, light, copper-coloured surface. When sufficiently thick, the deposit is removed with care, washed and placed to dry. Electrotype medals may be polished with wash-leather and the plate brush, or bronzed. Various natural objects such as insects, fruits, &c.; small works of art, such as busts and statuettes; chemical vessels, particularly glass flasks and retorts; and numerous classes of articles, may be rendered less fragile by coating them with copper by the electrotype process.

II. Deposition of the Precious Metals:

The solutions generally employed as electrolytes from which silver and gold are respectively separated, are those of the argento-cyanide and the auro-cyanide of potassium. When a solution of argento-cyanide of potassium is electrolysed, silver appears at one electrode and cyanogen at the other, while a proportionate amount of the simple cyanide of potassium is formed in the solution. But if the positive electrode is of silver the cyanogen combines with it, and forms cyanide of silver,

which unites with the liberated cyanide of potassium, and so keeps up the strength of the solution.

As in the deposition of copper, the apparatus used for plating or gilding may be the single cell or the decomposition cell and battery. The necessity of economising solutions of silver and gold has, however, led to certain modifications in the apparatus. If the single-cell arrangement is used, the object to be silvered or gilded is placed, with the cyanide solution, in the porous vessel, while the zinc is placed in the outer vessel, with the dilute sulphuric acid. The strength of the acid water acting upon the zinc must be regulated according to the work to be done. If the action between the acid and the zinc be too energetic the electricity developed will be more than sufficient to release pure metal, and hydrogen will be evolved, which will interfere with the deposition. The zinc is usually employed in the form of a cylinder completely surrounding the porous cell. In the battery arrangement the decomposition cell may be of porcelain or glass; the silver or gold employed to keep up the strength of the solution may be in plates, wires, or ingots. For plating small objects, a single cell of a Daniell's battery will afford ample decomposing power; gilding may be better accomplished by using 3 such cells. The battery arrangement is much more convenient, effective, and economical than the single-cell arrangement.

In gilding, the bath is heated to from 130°—212° F. On the large scale, electro-plating is carried out in oblong vats, occasionally holding from 200 to 250 galls. of solution. Silver plates connected with a powerful voltaic or magneto-electric battery, are placed at intervals in the vats; they form the positive electrodes, and correspond in extent of surface with the articles to be coated, and face them on both sides. The articles (tea-pots, cruet-frames, forks, spoons, &c.) act as the negative electrodes, and are suspended by copper wires from brass rods laid lengthways over the vats, and connected with the battery. The articles plated are usually formed of nickel silver or German silver, which is chosen on account of its silvery whiteness, a quality of great importance when portions of the coating of noble metal have been worn away by use.

To prepare the articles for plating, they are first boiled in a solution of potash, to free them from grease; they are then quickly dipped in red nitric acid, to remove any oxide that may have formed on the surface, and after this well washed in water, to remove every trace of acid. They are then suspended from copper wires, and dipped into a solution of mercury in cyanide of potassium, or some other mercurial solution, and afterwards washed in water as before. The amalgamation of the surface effected by the last operation promotes the adhesion of the film of silver. The articles having been weighed, are now immersed in the silvering solution, and left until a sufficient amount of silver has been deposited on them. Their condition at any time may be ascertained by weighing a test-object removed from the solution. In some electro-plating establishments the silvering solution is kept constantly stirred by simple mechanical arrangements; in others, continual motion is given to the suspended articles. On being removed from the vats, the plated articles are well brushed with brushes of fine brass wire attached to a lathe, and cleaned with fine Calais sand; they are afterwards polished on revolving brushes with rottenstone, then by hand with soft leather and rouge, and, lastly, with the naked female hand. A lasting polish is given to some articles by burnishing with a burnisher formed of highly polished hardened steel, bloodstone, agate, or flint. The process of electro-gild-

Table of Batteries used by Electro-platers.

Name of Battery.	Negative Element and Solution.	Positive Element and Solution.	E.M.F. of Cell.	Approximate Resistance of each Cell.	Work for which it is most Suited.
Daniell.	Copper in saturated solution of sulphate of copper	Zinc in sulphuric acid solution, 1 to 12 or 15	1·079 volts.	2 to 5 ohms.	Electro-gilding, silver-plating, and electro-typing.
Smee.	Platinised silver in dilute sulphuric acid, 1 to 10, 15, or 20	Zinc in dilute sulphuric acid, 1 to 10, 15, or 20	0·47 volts.	0·5 ohms.	Electro-gilding, silver-plating, and electro-typing.
Walker.	Platinised carbon in dilute sulphuric acid, 1 to 10, 15, or 20	Zinc in dilute sulphuric acid, 1 to 10, 15, or 20	0·66 volts.	0·4 ohms.	Electro-gilding, silver-plating, and electro-typing.
Bunsen.	Carbon in nitric acid	Zinc in sulphuric acid solution, 1 to 15 or 20	1·7 volts.	0·8 to 0·11 ohms.	Nickel-plating and copper-plating in alkaline solutions.
French Bunsen	Carbon in strong sulphuric acid	Zinc in sulphuric acid solution, 1 to 15 or 20	1·6 volts.	0·11 ohms.	Electro-gilding, silver-plating, copper-plating in alkaline solutions, and nickel-plating.

ing on the large scale is nearly the same as that of electro-plating or silvering, but, of course, plates of gold are suspended in the solution instead of silver plates.

Various solutions for silvering, plating, and platinising, have been recommended. We give below those generally employed.

1. Solvent solution. Cyanide of potassium, 2 oz.; distilled water or rain water, 1 pint; dissolve. Other proportions may be employed. Used as a general solvent for salts of silver, gold, and platinum.

2. Silver solution. Well-washed chloride of silver is dissolved in solution No. 1 until a saturated solution of the double salt is obtained; this is then diluted with an equal bulk of water.

3. Finely-divided gold is dissolved in aqua regia, the solution is evaporated to dryness on a water-bath, and the residue is then dissolved in the potassium cyanide solution No. 1.

4. Platinum solution. The double chloride of platinum and potassium dissolved in solution of caustic potash. Other solutions have been proposed, but this appears to be decomposed with the greatest ease.

Nickel-plating is conducted in exactly the same way as silver-plating, a bath of nickel-ammonium sulphate being used. The nickel deposit is not so white as that of silver, but it is more durable.

Zinc-plating. Iron plates may be coated with zinc by electrolysing a solution of the sulphate; but the 'galvanised iron' of commerce is made by placing the iron plates in a bath of molten zinc.

Electro-tinning. For this purpose a solution of tin in caustic soda is employed, the anode being of tin.

Electro-steeling. Iron is now deposited on the copper plates used for engraving in the following manner:—The bath is a solution of sulphate of iron and chloride of ammonium; to the copper pole of the battery a plate of iron, and to the zinc pole the engraved copper plate, are connected. These steeled plates serve for as many as 5000 to 15,000 impressions.

ELEC'TUARY. *Syn.* Electuarum, L. Electuaries (electuaria) are formed of light powders, generally vegetable, mixed up with honey, syrup, or sugar, to the consistence of a stiff paste. In the present Pharmacopœia they are included under the title Confection, but this arrangement is manifestly improper, as the words are not synonymous. In Conserves and Confections the addition of the saccharine matter is in much larger proportion, and is designed to preserve the vegetable matter; in Electuaries the syrup is designed merely to communicate the required form (*Dr Murray*).

The preparation of electuaries is similar to that of confections and conserves, and the same precautions must be observed to reduce the dry ingredients to very fine powder before adding them to the syrup or other substances used to give them form. Care must also be taken to diffuse the ingredients equally through every portion of the mass, by patient and laborious stirring. The neglect of this point has often led to disagreeable consequences, from some portion of the electuary being nearly inert, while another portion has possessed increased activity. See Confection, Conserve, Linctus, &c.

Electuary of Ac'etate of Potassa. See Conserve.

Electuary of Al'um. *Syn.* Electuarium aluminis, L. *Prep.* 1. (*Phœbus.*) Alum, 1 dr.; extract of logwood, 4 dr.; balsam of Peru, 6 drops; water of sage, q. s. Astringent and antiseptic; in diarrhœa, sponginess of the gums, &c.

2. (St Marie.) Alum, 1 dr.; catechu and extract of bark, of each, 2 dr.; conserve of roses, 6 dr.; simple syrup, q. s.—*Dose.* A teaspoonful every 4 hours; in chronic diarrhœa, leucorrhœa, hæmorrhage, &c. See Confection.

Electuary, An'odyne. *Syn.* Electuarium anodynum, L. *Prep.* See Confection of Opium.

Electuary, Anti'monial. *Syn.* Electuarium antimonii, Fr. *Prep.* Electuary of senna, 1 oz.; guaiacum resin, æthiops mineral, prepared sulphuret of antimony, of each, ½ oz.; syrup, q. s. —*Dose,* 1 dr. to 2 dr. twice a day.

Electuary, Anti-rheumatic. *Syn.* Electuarium antirheumaticum; Chelsea pensioner. *Prep.* Guaiacum resin, 1 dr.; rhubarb, 2 dr.; bitartrate of potash, 1 oz.; sulphur, 2 oz.; one nutmeg; mix the powders with 1 lb. of honey. Take two spoonfuls night and morning.

Electuary, Ar'abic. *Syn.* Electuarium sarzæ compositum, E. arabicum, L.; Electuaire arabique, Fr. *Prep.* From sarsaparilla, 5 oz.; senna and China root, of each, 3 oz.; dried walnut peel, 1 oz. (all in fine powder); honey, q. s. —*Dose,* 1 to 4 dr. See Traitement Arabique.

Electuary, Aromat'ic. *Syn.* Electuarium aromaticum (Ph. E.) This preparation differs from the aromatic confection of the other British colleges, in not containing chalk. It is aromatic and stomachic, but not antacid or absorbent. See Confection.

Electuary, Bath. *Syn.* Electuarium anticachecticum, E. martiale, E. ferri compositum, L. *Prep.* From blacksmiths' clinkers, reduced to an impalpable powder, and made into an electuary with honey or treacle, q. s.; afterwards adding powdered ginger and carbonate of magnesia, of each, 1 oz., to every lb. of the mixture.—*Dose.* A teaspoonful night and morning every day, for 3 or 4 days, and again, after an equal interval, as long as thought necessary; as a chalybeate tonic and in worms.

Electuary of Bitar'trate of Potas'sa. *Syn.* Electuarium potassæ tartratis, L. *Prep.* (*Monro.*) Cream of tartar, 1 oz.; powdered ginger and conserve of roses, of each, 1 dr.; syrup of orange peel, q. s.—*Dose,* 1 to 3 dr.; as a hydragogue purge. It is also a useful laxative in common cases. See Confection of Cream of Tartar.

Electuary, Black. *Syn.* Trousseau's electuary, Trousseau's black tonic; Electuarium nigrum, E. ferri tannatis, L. *Prep.* From sesquichloride of iron, 4 dr.; tannin, 1 dr.; confection of roses, 2 oz.; syrup of orange peel, 1 oz. Tonic and astringent.—*Dose,* 5 to 30 gr.

Electuary of Black Pep'per. See Confection of Pepper.

Electuary of Burnt Sponge. *Syn.* Electu-

ARIUM SPONGIÆ USTÆ, L. *Prep.* (*Hulse.*) Burnt sponge, 10 gr.; rhubarb, 4 gr.; conserve of roses, q. s. For a *dose*, to be taken night and morning; in scrofula, glandular swellings, &c. See CONFECTION OF SPONGE.

Electuary of Cas'sia. *Syn.* ELECTUARIUM CASSIÆ (Ph. D. 1826), E. C. FISTULÆ (Ph. E.), L. *Prep.* (Ph. D. 1826.) Fresh cassia pulp and syrup of orange, of each, ½ lb.; manna, 2 oz.; tamarind pulp, 1 oz.; mix, and evaporate to a proper consistence.—*Dose*, 2 dr. to 1 oz.; as a gentle laxative for children, or as a vehicle for other cathartics. That of the shops is commonly made with equal parts of tamarind and cassia pulps, mixed with 1-8th of manna, and flavoured with a few drops of tincture of orange peel, without any evaporation. See CONFECTION.

Electuary of Cat'echu. *Syn.* ELECTUARIUM CATECHU, CONFECTIO C., C. JAPONICA, L. *Prep.* (Ph. E.) Powdered catechu and kino, of each, 4 oz.; cinnamon and nutmegs, of each, 1 oz.; opium (dissolved in a little sherry), 1½ dr.; syrup of red roses (evaporated to the consistence of honey), 1½ pints. See CONFECTION and *below*.

Electuary of Catechu (Compound). *Syn.* ELECTUARIUM CATECHU COMPOSITUM (Ph. D.). See CONFECTIONS. Both the above are astringent, aromatic, and anodyne.—*Dose*, 15 gr. to 1 dr., or more; in diarrhœa, dysentery, &c.

Electuary, Cathar'tic. *Syn.* ELECTUARIUM CATHARTICUM, L. *Prep.* 1. Confection of senna, 1½ oz.; flowers of sulphur, ½ oz.; syrup of roses or of orange peel, q. s.—*Dose.* A teaspoonful 3 or 4 times a day, in piles; or 2 to 3 teaspoonfuls, as a gentle laxative for females, and in skin diseases, gonorrhœa, &c. A mild and excellent medicine. It may be safely given in large doses.

2. (*Brera.*) Aloes, 8 gr.; cream of tartar, 2 dr.; honey, q. s. For a dose. In amenorrhœa attributed to abdominal engorgement.

Electuary, Cephal'ic. *Syn.* ELECTUARIUM CEPHALICUM, E. VALERIANÆ COMPOSITUM, L. *Prep.* (Hosp. F.) Valerian root and mistletoe of the oak, of each, 1 oz.; honey, 1½ oz.; tincture of henbane, q. s. to make an electuary. In nervous and rheumatic headache, &c.; assisted by an aperient.

Electuary of Char'coal. *Syn.* ELECTUARIUM CARBONIS, E. CARBONII, CONFECTIO, C., L. *Prep.* 1. (Hosp. F.) Confection of senna, 2 oz.; fresh-burnt charcoal, ½ oz.; carbonate of soda, ¼ oz.; syrup of orange peel, q. s.

2. (*Radius.*) Electuary of senna, 2 oz.; powdered charcoal and carbonate of soda, of each, 1 dr. Both the above are given in obstinate constipation.—*Dose*, 1 to 3 teaspoonfuls twice a day. See ELECTUARY FOR THE TEETH.

Electuary for Chol'era. *Syn.* ELECTUARIUM ANTI-CHOLERICUM, L. The preparations that come under this name are numerous, including aromatic confection, and several like absorbent or astringent preparations. This name has been given to an American remedy for cholera noticed under CHOLERA.

Electuary of Cincho'na Bark. *Syn.* ELECTUARY OF BARK; ELECTUARIUM CINCHONÆ, L. *Prep.* 1. From yellow bark and simple syrup, of each, 1 oz.; conserve of red roses and confection of orange peel, of each, ½ oz. Tonic and febrifuge.—*Dose*, 1 to 4 dr.; in debility, agues, &c.

2. (*Radius.*) Peruvian bark, 1 oz.; syrup of orange peel, q. s. As the last.—*Dose.* A teaspoonful or more, 3 or 4 times daily (see *below*).

Electuary of Cinchona (Compound). *Syn.* ELECTUARIUM CINCHONÆ COMPOSITUM, L. *Prep.* 1. (ACIDULATED, *Copland.*) Yellow bark, 1 oz.; confection of roses, ½ oz.; diluted sulphuric acid, 1 dr.; syrup of ginger, 1½ oz.

2. (ASTRINGENT, *Saunders.*) Powdered Peruvian bark, orange peel, and conserves of roses and hips, of each, 6 dr.; crabs' eyes (or prepared chalk), 2 dr.; syrup of catechu, q. s.—*Dose.* A teaspoonful, 2 or 3 times daily; in chronic diarrhœa, &c.

3. (WITH CATECHU, *Pierquin.*) Peruvian bark, 1 oz.; catechu and balsam of tolu, of each, 1 dr.; syrup of comfrey (*Symphytum officinale*, Linn.), q. s.—*Dose.* As the last; in spitting of blood, hæmorrhages, &c.

4. (WITH CLOVES, *Dewees.*) Peruvian bark, 2 oz.; cloves, 1 dr. (better, 4 dr.); simple syrup, q. s. A piece the size of a walnut every hour or two, during the intermission of an ague.

5. (WITH IRON, *Cadet.*) Peruvian bark, 6 dr.; oxide of iron and confection of opium, of each, 2 dr.; syrup of cinnamon, q. s.—*Dose.* A teaspoonful, or more, twice a day; in dropsy of the belly, after the evacuation of the fluid, and as a tonic in debility, accompanied by nervous excitement, &c., in the absence of fever.

6. (*Quarin's.*) Red bark, 1 oz.; ammoniated iron, 1 dr.; made into an electuary with equal parts of oxymel of squills and syrup of the 'five roots' (diuretic). Tonic, febrifuge, and pectoral.

7. (WITH SAL-AMMONIAC, P. Cod.) Gray bark, 2½ oz.; hydrochlorate of ammonia, 1 dr.; honey and syrup of wormwood, of each, 2 oz. In intermittents occurring in scrofulous subjects.

8. (WITH SODA, P. Cod.) Powdered cinchona, 1 oz.; carbonate of soda, 2 dr.; thin mucilage, q. s., to mix. Tonic, febrifuge, and stomachic.—*Dose*, 2 dr., 2 or 3 times a day; in agues, complicated with acidity and dyspepsia.

9. (WITH SULPHUR, *Cadet.*) Peruvian bark, 1 dr.; sulphur crabs' eyes (chalk), and spermaceti, of each, 2 dr.; extract of opium, 4 dr.; conserve of roses, 4 dr.; syrup of milfoil, q. s. Highly praised in debility from phthisis.—*Dose.* A teaspoonful 2 or 3 times a day, assisted with the liberal use of raw or lightly boiled eggs and cod-liver oil.

10. (WITH TIN, *Cadet.*) Peruvian bark, 1 oz.; tin filings and valerian root, of each, ½ oz.; syrup of saffron, q. s. In epilepsy, worms, &c.—*Dose.* A teaspoonful, morning and evening. See CONFECTION OF BARK.

Electuary of Copai'ba. *Syn.* ELECTUARIUM COPAIBÆ, L. *Prep.* 1. Copaiba and powdered cubebs, equal parts; conserves of roses and orange peel, of each (in equal quantities), q. s.

3. (*Caspar.*) Blanched almonds, 6 dr.; powdered marsh-mallow root, 1 dr.; catechu, ½ dr.; balsam of copaiba, 3 dr.

3. (*Ricord.*) Confection of almonds, 1 oz.; copaiba, ½ oz.; hard extract of rhatany, 3 dr.;

syrup of orange peel, q. s. All the above are excellent in gonorrhœa, gleets, &c. The last two agree better with the stomach than most other like preparations.—*Dose,* 1 teaspoonful, or more (rapidly increased to 2 or 3 dr.), 3 or 4 times daily. See CONFECTION.

Electuary of Cow'hage. *Syn.* ELECTUARIUM DOLICHOS, E. MUCUNÆ, L. *Prep.* 1. Dip the pods of dolichos in treacle, allow them to drain a moment, and then scrape off the hairs for use.

2. (*Chamberlain.*) As last, nearly.

3. (*Correa.*) Cowhage (the hairs or setæ), 40 gr.; syrup, ½ oz.

4. (*Ellis.*) Cowhage (hairs), 1 dr.; honey, q. s.

5. (Guy's Hosp.) Cowhage (hairs), any quantity, made into electuary with treacle, q. s. In worms.—*Dose.* For a child, a teaspoonful; for an adult, a tablespoonful; in the morning, fasting, and at night, for 3 or 4 days; followed by a dose of castor-oil, to which a teaspoonful of turpentine may be advantageously added. See COWHAGE.

Electuary of Cu'bebs. *Syn.* ELECTUARIUM CUBEBÆ, L. *Prep.* 1. See ELECTUARY OF COPAIBA.

2. (*Beral.*) Cubebs and copaiba, of each, 2 oz.; powdered alum, 1 oz.; extract of opium, 5 6 gr. mix.

3. (*Bouchardat.*) Cubebs, 1½ oz.; copaiba, 1 oz.; sweet spirit of nitre, ½ fl. dr.; oil of peppermint, 8 or 10 drops; powdered sugar, q. s.

4. (*Radius.*) Cubebs, ½ oz.; honey, 1 oz. In gonorrhæa, mucous discharges from the vagina, bladder, &c.—*Dose,* 1 teaspoonful, afterwards increased to 2 or 3 teaspoonfuls, twice or thrice daily. See CONFECTION OF COPAIBA, ELECTUARY OF C., &c.

Electuary, Demul'cent. *Syn.* ELECTUARIUM DEMULCENS, L. *Prep.* From spermaceti, syrup of poppies, and syrup of tolu, of each, 2 dr.; powdered gum tragacanth, 1 dr.; confection of roses, 6 dr.; nitre, ½ dr.—*Dose.* A piece the size of a small filbert, frequently; as a pectoral and demulcent in coughs, hoarseness, &c.

Electuary, Deob'struent. *Syn.* ELECTUARIUM DEOBSTRUENS, L. *Prep.* (*Copland.*) Confection of senna, 1½ oz.; cream of tartar, 1 oz.; sulphur and syrup of ginger, of each, 6 dr.; borax, 3 dr.; syrup of poppies, 2 dr.—*Dose,* a teaspoonful, or more, nightly; in the obstinate constipation of females, painful and suppressed menstruation, &c.

Electuary for Dys'entery. *Syn.* ELECTUARIUM ANTI-DYSENTERICUM (Ph. E. 1744), L. Electuary of catechu, mixed with half its weight of Locatel's balsam.

Electuary, Emmen'agogue. *Syn.* ELECTUARIUM EMMENAGOGICUM, L. *Prep.* From myrrh, 1 dr.; ammoniated iron, 1 scruple; syrup of ginger, q. s. to mix.—*Dose,* ½ dr. to 1 dr., night and morning; in deficient or suppressed menstruation.

Electuary for Epilepsy. *Syn.* ELECTUARIUM ANTI-EPILEPTICUM, L. *Prep.* 1. See ELECTUARY OF CINCHONA (Comp.), No. 10.

2. (*Dr Mead.*) Powdered cinchona, 1 oz.; valerian and tin (both in powder), of each, ½ oz.; syrup, q. s. to mix.—*Dose.* A teaspoonful, night and morning.

Electuary, Feb'rifuge. See ELECTUARY OF CINCHONA, &c.

Electuary of Guaiacum (Compound). *Syn.* ELECTUARIUM GUAIACI COMPOSITUM. (Mid. H.) *Prep.* Guaiacum resin, 2 dr.; rhubarb, 1 dr.; sulphur, 2 dr.; nitre, 2 dr.; syrup of poppies, q. s.; mix.—*Dose,* ½ dr. to 1 dr.

Electuary of In'digo. *Syn.* ELECTUARIUM INDIGI, E. PIGMENTI INDICI, L. *Prep.* (*Phœbus.*) Powdered indigo, 4 dr.; aromatic powder, ½ dr.; syrup, 1 fl. oz. or q. s. In spasmodic diseases, especially in epilepsy, chorea, and hysteria, and the convulsions of children. It has also been used with advantage in that species of impotence in which strychnia is useful. The above quantity is to be all taken, in divided doses, during the day. To be of permanent advantage it should be continued for several weeks.

Electuary of Ipecacuan'ha. See CONFECTION.

Electuary of Jal'ap. See CONFECTION.

Electuary of Kermes. MARMELADE DE ZANETTI; ELECTUARIUM KERMETIS, E. K. MINERALIS, L. *Prep.* From manna, 4 oz.; pulp of cassia and oil of almonds, of each, 2 oz.; butter of cacao, ½ oz.; Kermes mineral, 10 gr.; syrup of marsh-mallow, 3 fl. oz.; syrup of orange flower, q. s. A diaphoretic laxative.—*Dose,* 1 to 4 teaspoonfuls, or more.

Electuary of Lau'rel Ber'ries. See CONFECTION OF RUE.

Electuary, Len'itive. See CONFECTION OF SENNA.

Electuary, Mahomed's. *Prep.* 1. From grocer's currants, 2 oz.; powdered senna, ½ oz.; powdered ginger, 1 dr.; finely powdered capsicum and cloves, of each, 20 gr.; croton oil, 3 drops; conserve of roses and syrup of saffron, of each, in equal parts, q. s. to mix.

2. (*Bateman.*) Currants, 1 oz.; senna, ½ oz.; ginger, ½ dr.; syrup of roses, q. s.; croton oil, 1 drop.—*Dose,* 1 or 2 teaspoonfuls, early in the morning; in dyspepsia and habitual constipation. The first formulary produces a most useful medicine, particularly for free-livers.

Electuary of Male Fern. *Syn.* ELECTUARIUM FILICIS MARIS, L. *Prep.* 1. Powder of male fern, 3 dr.; conserve of roses, 1 oz.

2. (*Radius.*) Ethereal extract of male fern, ½ dr.; honey of roses, 1 oz. The half of either to be taken at night, and the remainder the next morning. In worms.

Electuary, Mustard. *Syn.* ELECTUARIUM SINAPIS. (Guy's H.) *Prep.* Mustard seed, lightly bruised, 1 oz.; sulphur, 2 dr.; syrup of orange peel, 1 fl. oz.—*Dose,* 1 dr., 3 or 4 times a day.

Electuary of Ni'tre. *Syn.* ELECTUARIUM POTASSÆ NITRATIS, L. *Prep.* (Hosp. F.) Nitre, 3 dr.; confection of roses, 2 oz.—*Dose.* A piece of the size of a filbert, where the use of nitre is indicated. See CONFECTION.

Electuary, Olibanum. *Syn.* ELECTUARIUM OLIBANI. [Fr.] *Prep.* Olibanum, ½ oz.; balsam of copaiba, ½ oz.; conserve of hips, 1 oz.; syrup, q. s.—*Dose,* 2 dr. twice a day.

Electuary of O'pium. See CONFECTION OF OPIUM.

Electuary, Pec'toral. *Syn.* ELECTUARIUM PECTORALE, L. *Prep.* 1. (Ph. E. 1744.) From conserve of roses, 2 oz.; compound powder of

tragacanth, 4 dr.; flowers of benzoin, 1 dr.; syrup of tolu, q. s.—*Dose.* A little, *ad libitum.*

2. Oxymel of squills, syrup of marsh-mallows, mucilage of gum-arabic, and syrup of tolu, of each, ½ oz.; powdered lump sugar, 2 oz. As the last.

Electuary of Pep'per. See CONFECTION, and *above.*

Electuary for Piles. *Syn.* ELECTUARIUM HÆMORRHOIDALE, L. *Prep.* 1. See CONFECTION and ELECTUARY OF PEPPER.

2. (*Dr Copland.*) Cream of tartar, 1 oz.; precipitated sulphur (pure), 3 dr.; confection of senna, 2 oz.; syrup of orange peel or ginger, q. s. to mix.

3. (*Dr Graves.*) Confection of senna and sulphur, of each, 1 oz.; balsam of copaiba and cream of tartar, of each, ½ oz.; jalap and ginger, of each, 1 dr.; syrup of orange peel, q. s.

4. (Hosp. F.) Confection of senna, 2 oz.; black pepper and precipitated sulphur, of each, ¼ oz.; oil of cubebs, 1 dr.; syrup, q. s. The last 3 are useful laxatives in piles, and by their preventing the accumulation and hardening of the fæces, often remove the affection.—*Dose.* A teaspoonful, 3 or 4 times a day. From the difficulty experienced in procuring pure precipitated sulphur, washed sublimed sulphur may be advantageously substituted.

Electuary of Pomegran'ate. *Syn.* ELECTUARIUM GRANATI, L. *Prep.* 1. From the root-bark, 1 dr.; assafœtida, ½ dr.; croton oil, 6 drops; conserve of roses, 1 oz.—*Dose.* A teaspoonful, night and morning.

2. (*Radius.*) Extract of the root-bark, 6 dr.; lemon juice, 2 fl. dr.; linden water, 3 fl. dr.; gum-tragacanth, q. s. to make an electuary. One half to be taken at once; the remainder in an hour. Both are given in tapeworm.

Electuary of Prunes. *Syn.* ELECTUARIUM PRUNONUM. (*Zwelfer.*) *Prep.* Pulp of prunes boiled to a due consistence, 2 lbs.; pure sugar, 1 lb.

Electuary of Resin. See CONFECTION OF RESIN.

Electuary of Rhubarb. *Syn.* ELECTUARIUM RHEI, L. *Prep.* (*Saunders.*) Powdered rhubarb, 1½ dr.; sulphate of potassa, 1 dr.; cream of tartar, 4 dr.; pulp of tamarinds, 2 oz.—*Dose.* A teaspoonful, as a mild stomachic laxative.

Electuary, Compound Saffron. *Syn.* ELECTUARIUM CROCI COMPOSITUM, L.; CONFECTION D'HYACINTHE, Fr. *Prep.* Prepared Armenian bole, 8 oz.; levigated crab's eyes, 8 oz.; cinnamon, 3 oz.; yellow sandal, red sandal, myrrh, of each, 1 oz.; dittany of Crete, 1 oz.; all in fine powder. On the other hand, dissolve 1½ lbs. of honey in 3 lbs. of syrup of pinks over a gentle fire, and strain, and when nearly cold stir into it 1 oz. of saffron in powder. Let stand 12 hours, and then stir in carefully the powders first mentioned.

Electuary of Scam'mony. See CONFECTION.

Electuary for Scur'vy. See CONSERVE (Anti-scorbutic).

Electuary of Sen'na. See CONFECTION OF SENNA.

Electuary of Squills. *Syn.* ELECTUARIUM SCILLÆ, L. *Prep.* 1. Oxymel of squills, 2 fl. oz.; cream of tartar and powdered sugar, of each, 1½ oz.—*Dose,* 1 to 2 teaspoonfuls, as a laxative and expectorant; in old coughs, &c.

2. (*Radius.*) Squills, nitre, gum-ammoniacum, and tartrate (bitartrate) of potassa, of each, 2 dr.; sal-ammoniac, 20 gr.; syrup of cinnamon, q. s.—*Dose,* 2 dr., 3 times a day; in dropsies. See CONSERVE OF SQUILLS.

Electuary of Steel. *Syn.* ELECTUARIUM FERRI, E. CHALYBEATUM, L. *Prep.* 1. (*Dr Collier.*) Potassio-tartrate of iron, ½ oz.; confection of roses, 1 oz.; syrup, q. s. to mix.

2. (*Collier.*) Precipitated sesquioxide of iron, 1 oz.; honey, 2 oz.; ginger syrup, ½ fl. oz. Both the above are tonic and emmenagogue.—*Dose.* One teaspoonful thrice a day. See CONFECTION.

Electuary, Stim'ulant. *Syn.* ELECTUARIUM STIMULANS, L. *Prep.* From gum-ammoniacum (strained), 1 oz.; vinegar of squills, ½ oz.; mixed with a gentle heat and spread on leather. Applied to the chest or pit of the stomach as a mild counter-irritant and anti-spasmodic; and as a discutient to tumid glands and indolent tumours. It is wrongly called an electuary.

Electuary, Stomach'ic. *Syn.* DINNER ELECTUARY; ELECTUARIUM STOMACHICUM, CONFECTIO STOMACHICA, L. *Prep.* 1. Rhubarb, ginger, and extract of chamomile, of each, 1 dr.; confection of orange peel, 4 dr.; syrup, q. s.

2. Rhubarb and gentian, of each, 1½ dr.; extract of hops and powdered capsicum, of each, ½ dr.; oil of chamomile, 12 drops; confection of hips and syrup of orange peel, of each, ½ oz.

3. Green peppermint, lump sugar, and confection of orange peel, equal parts.—*Dose.* A teaspoonful an hour before a meal. They are all excellent stomachics, and are useful to improve the appetite, and in dyspepsia.

Electuary of Sul'phur. See CONFECTION OF SULPHUR, and *below.*

Electuary of Sulphur (Compound). *Syn.* ELECTUARIUM SULPHURIS COMPOSITUM, L. *Prep.* 1. Sulphur, ¾ oz.; cream of tartar, 1 oz.; confections of senna and black pepper, of each, 2 oz.; syrup of ginger, 1 fl. oz. An excellent medicine in piles.—*Dose.* A teaspoonful twice a day.

2. (WITH BORAX.) Flowers of sulphur, 1 oz.; cream of tartar, 1½ oz.; borax, ½ oz.; confection of senna, 2½ oz.; syrup of orange peel, q. s. to mix.—*Dose,* 1 to 3 teaspoonfuls, in diseases of the uterine organs and lower bowels. See CONFECTION.

Electuary for the Teeth. *Syn.* ELECTUARIUM DENTIFRICUM, L. See TOOTH PASTE, DENTIFRICE, &c.

Electuary of Tin. See CONFECTION OF TIN, and *below.*

Electuary of Tin (Compound). *Syn.* ELECTUARIUM STANNI COMPOSITUM, L. *Prep.* 1. Powdered tin, 1 oz.; confection of oil of turpentine, 2 oz.

2. (*Dr Cheston.*) Tin filings, 4 dr.; carbonate of iron (sesquioxide), 1 dr.; conserve of wormwood, 3 dr.

3. (*Foy.*) Powder of tin, 1 oz.; extract of wormwood and powdered jalap, of each, 1 dr.; compound syrup of chicory, q. s. In worms.—*Dose.* A tablespoonful, or more, for 2 or 3 successive mornings, fasting; followed by a purge.

Electuary of Tur'pentine. *Syn.* ELECTUARIUM

TEREBINTHINÆ, L. *Prep.* 1. (St B. Hosp.). Common turpentine, 1 oz.; honey, 2 oz.—*Dose,* 1 to 2 teaspoonfuls; in complaints of the urinary organs, worms, &c.

2. (*Radius.*) Turpentine, soap, and rhubarb, of each, 1 dr.; syrup of wormwood, q. s.—*Dose,* 3 teaspoonfuls a day; in dropsy, worms, &c.

3. (E. OLEI TEREBINTHINÆ, *Copland.*) As confection of turpentine, Ph. D. See CONFECTION.

Electuary, Ver'mifuge. *Syn.* ELECTUARIUM ANTHELMINTICUM, E. VERMIFUGUM, L. *Prep.* 1. (*Bresmer.*) Worm-seed and tansy-seed, of each, 4 dr.; powdered valerian root, 2 dr.; jalap and sulphate of potassa, of each, 1½ to ½ dr.; oxymel of quills, q. s. to mix.—*Dose.* A teaspoonful, or more; repeated night and morning, followed by a brisk purge.

2. (*Rosenstein.*) Worm-seed, 10 gr.; sulphate of iron, 4 gr.; jalap and honey, of each, 20 gr. For 2 doses, as the last. 2 or 3 dr. of confection of senna are often substituted for the jalap and honey.

3. (*Foy.*) Aloes, ½ oz.; common salt, 3 dr.; flour, 2 oz.; honey, q. s. to form a stiff paste. Used as a suppository in ascarides.

4. Flowers of sulphur, 4 oz.; powdered jalap, 1 oz.; powdered bark, 1 oz.; syrup of buckthorn, q. s.—*Dose,* 2 or 3 teaspoonfuls every morning early. See CONFECTION and ELECTUARY OF TIN, TURPENTINE, WORM-SEED, &c.

Electuary for Worms. See ELECTUARY VERMIFUGE (*above*).

EL'EMENTS. *Syn.* ELEMENTARY BODIES, SIMPLE B.; ELEMENTA, L. In *chemistry,* those substances or bodies which have hitherto resisted every attempt which has been made to decompose them, or to resolve them into simpler forms of matter. Earth, air, fire, and water were regarded by the ancients as simple bodies, of which all others are composed, and they are still sometimes spoken of figuratively as the elements. The imaginary principles or elements of the alchemists were termed salt, sulphur, and mercury. About 64 different kinds of matter are at present recognised as elementary bodies. They are substances having the most diverse characters. The great majority exist in the solid state; bromine and mercury are liquid; while oxygen, hydrogen, nitrogen, chlorine, and fluorine are gaseous. About 4-5ths of the elements are metallic—gold, silver, copper, iron, &c.; the remainder are nonmetallic, as instanced by carbon, sulphur, phosphorus, &c. A list of the known elements is given under the head of ATOMIC WEIGHTS (which *see*).

EL'EMI. *Syn.* GUM-ELEMI; ELEMI (B. P.) "A concrete resinous exudation, from an uncertain plant." MEXICAN ELEMI is known to be the produce of a species of the genus *Elaphrium.* MANILLA ELEMI is probably the product of *Canarium commune.*

Prop., &c. The elemi of commerce is of a pale-yellow colour, brittle without, but soft and tough within; it has a warm bitter taste, and a fragrant aromatic smell, partaking of fennel and juniper. It is only partially transparent, even in thin plates; is very fusible, and has a density a little greater than that of water. Moistened with rectified spirit it breaks into small crystalline particles consisting of *Amyrine.* It contains 12½% of volatile oil (oil of elemi). It is used to give toughness to lacquers and varnishes, and in *medicine,* in the preparation of ELEMI OINTMENT.

Pur. The elemi of the shops is often adulterated, but more frequently a factitious kind is sold for the genuine gum. This fraud may be detected by exposing the suspected article to heat, along with a little water, when the factitious fragrance of the spurious articles evaporates, and the coarse terebinthinate smell of the resin used to adulterate it, or which is sold for it, becomes readily distinguishable.

Elemi, Factitious. *Prep.* 1. Yellow resin, 8 lbs.; melt, add Canada balsam, 2 lbs.; withdraw the vessel from the heat, and further add of oil of juniper, 2 dr.; oil of sweet fennel, 1 dr.; oil of nutmeg, ½ dr.

2. Yellow resin, 7 lbs.; Canada balsam, 1 lb.; juniper oil bottoms, 4 dr.; oil of mace, 3 dr.; mix as before.

ELIX'IR. In *pharmacy,* a name formerly applied to various compound tinctures and to preparations supposed to contain the quintessence of other substances. (It is still applied to several popular remedies.) The elixirs of the alchemists were solutions employed in their fruitless attempts to transmute the baser metals into gold.

Elixir, Ac'id. *Syn.* ELIXIR ACIDUM, L. *Prep.* 1. (*Dippell's.*) Sulphuric acid, 1 part, dropped gradually into rectified spirit of wine, 5 parts; placed in a large flask, and afterwards coloured by digestion on animal kermes and saffron, of each, 1 part.

2. (*Haller's,* Ph. Sax. 1837.) From sulphuric acid and rectified spirit, of each, 1 part; as before.

3. (*Vogler's.*) From sulphuric acid and nitrous ether, equal parts, as *above.* Astringent and antiseptic.—*Dose.* A few drops, in water.

Elixir of Al'oes. *Syn.* COMPOUND TINCTURE OF ALOES; ELIXIR ALOËS, L. See TINCTURE.

Elixir of Aloes (Compound). *Syn.* ELIXIR OF ALOËS COMPOSITUM, L. *Prep.* (*Dr Copland.*) Acetate of potassa, inspissated ox-gall, socrotine aloes, and myrrh, of each, 2 dr.; hay saffron, 1 dr.; brandy (or proof spirit), 2½ fl. oz.; digest a week, and strain. Stomachic and laxative.—*Dose.* A teaspoonful, or more; in dyspepsia, constipation, &c.

Elixir, Anti-asthmat'ic. *Syn.* ELIXIR ANTIASTHMATICUM, L. *Prep.* 1. Oil of aniseed, camphor, balsam of tolu, of each, 1 oz.; cochineal, 1 dr.; proof spirit, 1 gall.; digest a week, and filter.

2. As the last, adding powdered opium, 1¼ oz. —*Dose.* A teaspoonful to allay irritation, assisted by an occasional dose of aperient medicine; in asthma, chronic coughs, &c.

3. (*Boerhaave's.*) Aniseed, asarabacca, elecampane, liquorice-root, orris-root, and sweet flag (calamus), of each, equal parts; made into a tincture, with brandy.—*Dose,* 20 to 40 drops.

Elixir Antigoutteux de Villette is a tincture of 100 parts brown cinchona bark, 50 parts poppy petals, 25 parts sassafras, 50 parts guaiacum in 4000 parts rum, mixed with 2500 parts syrup of sarsaparilla (*Hager*).

Elixir, Anti-scrof′ulous. *Syn.* ELIXIR ANTI-SCROFULOSUM, L. *Prep.* 1. (P. Cod.) The ammoniated tincture of gentian. See TINCTURE.

2. (*Desforges.*) Guaiacum, 5 oz.; cinchona bark and pellitory, of each, 3 oz.; cloves, 5 dr.; orange peel and benzoin, of each, 2 dr.; hay saffron, ½ dr.; rectified spirit and brandy, of each, ½ pint; digest a week, and filter. Used as an application to scorbutic gums.

Elixir Bismuthi. Citrate of bismuth, 160 gr.; distilled water, 2 oz.; solution of ammonia, 2 dr., or sufficient to dissolve the bismuth. Dissolve, filter, and add simple elixir to make 10 oz. Sedative in dyspepsia. *Dose*, 1 to 2 dr.

Elixir, Bitter. *Syn.* ELIXIR AMARUM. (Ph. Germ.) *Prep.* Extract of buckbean, extract of orange peel, of each, 2 parts; peppermint water, alcohol (68%), of each, 16 parts; spirit of ether (made of 3 parts of alcohol and 1 part of ether), 1 part. Dissolve and mix.

Elixir, Boerhaave's Asthmat′ic. See ELIXIR, ANTI-ASTHMATIC (*above*).

Elixir, Boerhaave's Vis′ceral. *Syn.* ELIXIR BOERHAAVII, E. B. VISCERALE, L. *Prep.* (Ph. Han.) Aloes, myrrh, and saffron, of each, 1 oz.; tartrate of potassa, 2 oz.; alcohol (strongest rectified spirit), 14 oz.; water, 1 oz.; macerate 3 days, and filter. This preparation "has been highly praised in visceral obstruction" (*Dr Griffith*).—*Dose*, 1 to 3 teaspoonfuls.

Elixir, Camphoræ. Spirit of camphor, 10 dr.; syrup, 5 dr.; water, 1 dr. Stimulant and antispasmodic.—*Dose*, ½ to 1 dr.

Elixir, Cascara Sagrada. (B. P. C.) Tincture of fresh orange peel, 2 oz.; rectified spirit, 1 oz.; cinnamon water, 3 oz.; syrup, 6 oz.; liquid extract of cascara sagrada, 8 oz. A pleasant laxative in constipation.—*Dose*, ½ to 2 dr.

Elixir of Celery. (*Dr Wilkinson's.*) For increasing, preserving, and producing virility. Juniper berries, angelica root, lovage root, of each, 1 part; spirit, 12 parts; orange-flower water, rose-water, of each, 4 parts; spring water, sufficient. Distil 20 parts, and mix the distillate with 12 parts clarified honey (*Hager*).

Elixir, Cinchonæ. Liquid extract of cinchona, 1 oz.; simple elixir, 7 oz. Astringent tonic.—*Dose*, ½ to 1 dr.

Elixir, Claude's. *Syn.* ELIXIR CLAUDERI, L. 1. (*Pideret.*) Salt of tartar, sal-ammoniac, strained aloes, and myrrh, of each, 1 oz.; elder-flower water, 1¼ pints; digest with agitation for 24 hours and filter.

2. (*Parrish.*) Carbonate of potassa, 1 oz.; aloes, guaiacum, myrrh, saffron, and rhubarb (contused), of each, 2 dr.; water, 18 fl. oz. Macerate a few days, and decant.—*Dose*, 1 to 2 teaspoonfuls; in amenorrhœa, constipation, scurvy, visceral obstructions, &c.

Elixir, Cocæ. Liquid extract of coca, 1 oz.; simple elixir, 6 oz. Tonic and stimulant.—*Dose*, 1 to 4 dr.

Elixir, Cough. *Syn.* ELIXIR ANTI-CATARRHALE, L. *Prep.* 1. See ANTI-ASTHMATIC ELIXIR.

2. (*Hufeland.*) Extracts of blessed thistle and dulcamara, of each, 1 dr.; cherry-laurel water, 1 fl. dr.; fennel-water, 1 fl. oz.—*Dose*, 1 to 2 teaspoonfuls, 3 or 4 times a day. It is a most useful remedy in coughs occurring in nervous, hysterical, or irritable patients. See ELIXIR OF IPECACUANHA, ELIXIR, LETTSOM'S, &c. (*below*).

Elixir, Daffy's. *Syn.* ELIXIR SALUTIS, E. SENNÆ COMPOSITUM, TINCTURA SENNÆ COMPOSITA, L. This is an aromatised and sweetened tincture of senna, to which other cathartics are generally added. Nearly every drug-house has its own formula for this article. The following are those employed in the London trade:

Prep. 1. East Indian senna, 1½ lbs.; jalap, 5 oz.; coriander seed and aniseed, of each, ½ lb.; rhubarb, ¼ lb.; red sanders wood, 2 oz.; salt of tartar, 2 oz.; treacle, 7 lbs.; rectified spirit of wine, 2½ galls.; water, 3¼ galls. All the solids are well bruised and macerated in the mixed fluids for 14 days, when the whole is pressed, and strained through a flannel bag. It is too glutinous to run through filtering paper.

2. Senna, rhubarb, and aniseed, of each, 2 lbs.; jalap and caraways, of each, 1 lb.; red sanders wood, ½ lb.; brown sugar, 7 lbs.; proof spirit, 10 galls.; as the last.

3. Senna, 56 lbs.; aniseed, 7 lbs.; rhubarb (East Indian), 14 lbs.; coriander seed, 6lbs.; caraway seed and red sanders wood, of each, 5 lbs.; cassia bark and jalap, of each, 3 lbs.; proof spirit, 100 galls.; digest for 14 days, press, strain, and add molasses, 84 lbs.; mix well, and either clarify or strain through flannel.

4. For proof spirit in the last 2 formulæ, equal parts of spirit of wine and water are employed by the smaller houses.

5. (*Redwood.*) Senna, ½ lb.; aniseed, caraways, and jalap, of each, 1 oz. 2 dr.; juniper berries, 2½ oz.; proof spirit, 6 pints; macerate for 14 days, then add of treacle, 10½ oz.; water, 1 lb. 5 oz.; mix and strain.

6. (*Dicey's.*) Senna, 1 lb.; guaiacum shavings, elecampane root (dried), aniseed, caraway seed, coriander seed, and liquorice root, of each, ½ lb.; stoned raisins, 2 lbs.; proof spirit or brandy, 9 quarts; macerate for 10 days.

7. (*Swinton's.*) Senna, 1 lb.; jalap, 3 lbs.; coriander seed, caraway seed, liquorice root, and elecampane root, of each, 4 oz.; moist sugar, 2 lbs.; rectified spirit of wine and water, of each, 1 gall.; as the last.

Obs. Daffy's elixir is a favourite purge with drunkards, and is a common and very popular remedy in flatulent colic, dyspepsia, diarrhœa, &c. —*Dose*, 1 to 4 tablespoonfuls or more.

Elixir de Pepsia Digestif. (*Grimault and Co.*) For loss of appetite and disordered digestion. Contains pepsine, in quantities not at all proportionate to the price of the article.

Elixir, Deslaurier's Toni-Febrifuge au Quinquina et Caffé. A tonic febrifuge. Yellow cinchona (Köningschina), 20 grms.; brown cinchona, 8 grms.; powdered coffee beans, slightly roasted, 16 grms.; wine, 250 grms.; sugar, 15 grms.; citric acid, 2·5 grms. Boil once after standing some time in a warm place, and filter. Add to the filtered liquid 85 grms. sugar and 15 grms. spirit.

Elixir de St Hubert pour les Chasseurs is a solution of 2 parts carbolic acid in 50 parts spirit (*Casselman*).

Elixir, Devil's. *Syn.* ELIXIR CAPSICI COMPOSITUM, L. *Prep.* From pods of capsicum, and cloves (bruised), of each, 1 oz.; ginger and saffron, of each, 3 oz.; cantharides, 5 dr.; proof spirit, 7 lbs.; digest for 10 days.—*Dose*, ½ dr. to 3 dr., in mixtures. It is stimulating, anti-choleraic, and aphrodisiac.

Elixir Ferric Quininæ et Strychniæ Phosphatum. Prepared in the same manner as the syrup of phosphate of iron, quinine, and strychnine, substituting simple elixir for the simple syrup.

Elixir of Garlic. *Syn.* ELIXIR ALLII, L. *Prep.* From garlic root (bruised), 80 in number; rectified spirit, 1 pint; digest, distil to dryness, and repeat the process with the same spirit from fresh roots, a second and third time; lastly, add camphor, 2 dr. Diaphoretic and pectoral.—*Dose.* A teaspoonful twice a day; in asthma, old coughs, diarrhœa from debility, &c.

Elixir, Garus's. *Syn.* ELIXIR GARI, L.; ELIXIR DE GARUS, Fr. *Prep.* 1. Myrrh, 1 oz.; aloes and saffron, of each, ½ oz.; cinnamon, cloves, and nutmeg, of each, 1 dr.; proof spirit, 1 quart; digest a week, add water, 5 fl. oz., and distil over 1 quart; to the distillate (ALCOOLAT DE GARUS) add of syrup of maidenhair, 2 lbs.; orange-flower water, 1½ oz.

2. (*Foy.*) Compound tincture of saffron, 8 pints; syrup of maidenhair, 10 pints; mix; add caramel, q. s. to colour, dissolved in orange-flower water, ½ pint.

3. (P. Cod.) Aloes and saffron, of each, 1 oz.; myrrh, cinnamon, and cloves, of each, ½ oz.; nutmeg, ½ dr.; proof spirit, 12 pints; orange-flower water, 16 fl. oz.; macerate 2 days, distil 6 pints, and add to the distillate (ALCOOLAT DE GARUS), of syrup of capillaire, 7½ pints; and colour with saffron, q. s.

4. (*Soubeiran.*) Socotrine aloes and saffron, of each, 1 oz.; myrrh, canella alba, citron, and nutmegs, of each, ½ oz.; spirit (sp. gr. ·923), 20 lbs.; orange-flower water, 16 fl. oz.; macerate as last, distil 10 lbs., and add to the distillate (ALCOOLAT DE GARUS), of syrup of capillaire, 12½ lbs.; orange-flower water, 8 fl. oz.; with saffron q. s. to colour.

5. (*Thierry.*) Aloes, myrrh, and saffron, of each, 2 dr.; nutmeg, 4 dr.; canella alba and cloves, of each, 1 oz.; spirit (·864), 13 lbs.; draw over 12 lbs. of 'alcoolat;' add to the residue of the distillation rose water, 10 lbs.; distil 6 lbs., and add as much of this aromatic water to the alcoolat as will raise its sp. gr. to ·890. Then to every 11 lbs. of the above mixed liquor add of simple syrup, 15 lbs.; tincture of vanilla and orange peel, of each, 2½ fl. oz.; fresh milk (skimmed), 1 lb.; and tincture of saffron, q. s. to colour; digest with agitation for 2 days, and filter. Used as a stomachic, carminative, and stimulant, in doses of a wine-glassful. That prepared without distillation forms an excellent stomachic purge. With the exception of that from the 2nd formula, the products may be regarded as agreeable cordial liquors rather than medicines. It is much employed on the Continent.

Elixir of Gold. *Syn.* ELIXIR AURII, L.; ELIXIR D'OR, Fr. *Prep.* 1. De la Motte's Golden Drops.

2. Terchloride of gold, 20 gr.; rectified spirit, 6 fl. dr.; ether, 3 fl. dr.; dissolve.—*Dose*, 5 to 15 drops, taken in distilled water; in gout, scrofula, nervous diseases, cancer, indurated glands, secondary syphilis, &c. This last preparation is often confounded with the *gouttes d'or du Général de la Motte;* but the two are evidently distinct articles. See DROPS.

Elixir, Guaranæ. (B. P. C.) Guarana in powder, 4 oz.; light magnesia, ½ oz.; oil of cinnamon, 6 minims; syrup, 2 oz.; proof spirit, a sufficiency. Mix intimately the powders, and moisten them with 3 fl. oz. of proof spirit. After 24 hours' maceration, mix with 8 oz. of coarse sand and pack in a percolator; pass through proof spirit until 16 oz. are obtained, then transfer the mass to a press-bag and apply pressure. To the percolate add the syrup and oil of cinnamon, and make up to 1 pint by addition of the expressed liquid, previously reduced by evaporation if necessary.—*Dose*, ½ to 2 fl. dr. Nervine tonic and diuretic; used to relieve sick headache.

Elixir, Haller's. See ELIXIR ACID (*above*).

Elixir, Hoffman's Visceral. *Syn.* ELIXIR HOFFMANNI, E. H. VISCERALE, L. *Prep.* 1. As ELIXIR OF ORANGE PEEL (Ph. Bor. 1847).

2. Thin outside peel of orange (dried), myrrh, and centaury, of each, 2 dr.; extracts of *Carduus benedictus*, cascarilla, and gentian, of each, 1 dr.; white wine (sherry), 1 quart. Aromatic and stomachic.—*Dose.* A dessert-spoonful, or more.

Elixir for Impotence in Males. (*Dr Ludwig Tiedemann.*) Prepared from directions given in the Puntsaou from genuine ginseng root. 135 grms. of a dark-brown aromatic vinous liquid, prepared by digesting orange-berries in wine. The embrocation is an equal quantity of a pleasantly smelling liquid consisting of spirit with tincture of storax and a small admixture of volatile oils (*Hager*).

Elixir of Ipecacuan'ha. *Syn.* ELIXIR IPECACUANHÆ, L. *Prep.* (*Cadet.*) Powdered ipecacuanha and balsam of tolu, of each, 4 dr.; flowers of benzoin, opium, and saffron, of each, 2 dr.; oil of aniseed, 1 dr.; camphor, 40 gr.; alcohol (rectified spirit), 1½ pints; digest a week and filter.—*Dose*, 1 to 2 dr., as a stimulant, diaphoretic, expectorant, and stomachic; in chronic coughs, asthmas, and old colds, and in certain forms of deficient appetite, dyspepsia, diarrhœa, &c.

Elixir of Jal'ap. *Syn.* ELIXIR JALAPÆ COMPOSITUM, L. *Prep.* From jalap, 4 oz.; scammony, 4 dr.; gamboge, 2 dr.; proof spirit, 1 quart.—*Dose*, ½ dr. to 3 dr., as a purgative; especially in worms.

Elixir Karoly pour les Fourrures. A solution of camphor and carbolic acid in strong spirit, mixed with a clear brown acrid tincture, perhaps tinct. pyrethri rosei (*Casselmann*).

Elixir, Lettsom's. *Prep.* (*Augustin.*) Oil of aniseed, 1 dr.; camphor, 1½ dr.; benzoic acid, opium, and saffron, of each, 2 dr.; ipecacuanha and balsam of tolu, of each, 4 dr.; rectified spirit, 2 lbs.; digest 10 days and filter.—*Dose*, 5 to 15 drops for a child, ½ to 1 teaspoonful for an adult; in ordinary coughs, whooping-cough, &c.

Elixir of Life, Bitter. (*Jacob Wolff.*) For

strengthening the constitution. A brandy prepared from 1 grm. aloes, 10 grms. cinnamon, 2·5 grms. sweet flag, 5 grms. angelica root, 6 grms. cake saffron, 10 grms. caramel, 215 grms. glycerin, 180 grms. spirit, 350 grms. water (*Hager*).

Elixir, Live-long. *Syn.* ELIXIR OF LONG LIFE; E. LONGÆ VITÆ, L. *Prep.* 1. See TINCTURE OF RHUBARB AND ALOES.

2. (ELIXIR VITÆ MATTHIOLI.) A mixture of several aromatics and stimulants, made with rectified spirit.

Elixir of Myrrh. *Syn.* ELIXIR MYRRHÆ, L. See TINCTURE OF SAVINE (Comp.) (Ph. L. 1788).

Elixir d'Or. See ELIXIR OF GOLD.

Elixir of Or'ange Peel. *Syn.* ELIXIR AURANTIORUM COMPOSITUM, L. *Prep.* 1. (Ph. Bor. 1847.) Orange peel, 6 oz.; cinnamon, 2 oz.; carbonate of potassa, 1 oz.; Madeira wine, 4 lbs.; macerate 6 days, express the tincture, and add of extracts of buckbean, cascarilla, gentian, and wormwood, of each, 1 oz.; dissolve, and after repose for subsidence, decant and filter. An excellent aromatic bitter and stomachic.

2. (*Moscati.*) Orange peel, 1 oz.; cascarilla, ½ oz.; waters of citron peel and wormwood, and rectified spirit, of each, ½ pint; digest a week. Resembles the last.—*Dose* (of either). A tablespoonful to a wine-glassful.

Elixir, Paracelsus's. See ELIXIR PROPRIETATIS (*below*).

Elixir, Parego'ric. *Syn.* ELIXIR PAREGORICUM, L. See TINCTURE OF CAMPHOR (Comp.).

Elixir, Paregoric (Scotch). *Syn.* ELIXIR PAREGORICUM SCOTICUM, L. See TINCTURE OF OPIUM (Ammoniated).

Elixir, Pec'toral. *Syn.* ELIXIR PECTORALE, L. (Ph. E. 1745.) Balsam of tolu, 2 oz.; gum benzoin, 1½ oz.; saffron, ½ oz.; rectified spirit, 32 fl. oz.; digest in a gentle heat for 4 days and filter.—*Dose*, ½ to 1 teaspoonful (see *above*).

Elixir Phosphori (Compound). (B. P. C.) Tincture of phosphorus, 1 dr.; glycerin, 4 dr.—*Dose*, 15 minims to 1 dr. It is palatable and easily borne by the stomach.

Elixir, Pol'ychrest. *Syn.* ELIXIR POLYCHRESTON, L. *Prep.* (Ph. E. 1745.) Guaiacum (gum), 6 oz.; balsam of Peru, ½ oz.; rectified spirit, 23 fl. oz.; digest as last, strain, and add oil of sassafras, 2 fl. dr. Pectoral and antirheumatic.—*Dose*, 10 to 60 drops, or more.

Elixir Proprieta'tis. [L.] *Syn.* PARACELSUS'S ELIXIR OF PROPRIETY; ELIXIR DE PROPRIÉTÉ DE PARACELSE, Fr. An old preparation nearly corresponding to the compound tincture of aloes of modern pharmacy, and which is now sold for it. *Prep.* 1. (*Soubeiran.*) Tincture of myrrh, 4 oz.; tinctures of aloes and saffron, of each, 3 oz. ('Trait. Pharm.' 1847).

2. (ELIXIR PROPRIETATIS CUM ACIDO.)—*a.* The last, slightly acidulated with oil of vitriol, and filtered.

b. (Ph. Bor. 1847.) Aloes and myrrh, of each, 2 oz.; saffron, 1 oz.; spirit (sp. gr. ·900), 2 lbs.; dilute sulphuric acid (1 to 5), 2 oz.; macerate 4 days, and filter.

3. (ELIXIR PROPRIETATIS TARTARIZATUM; E. P. ALKALIZATUM.) From elixir proprietatis, alkalised with salt of tartar, and filtered. The last two are old preparations, now seldom inquired for in this country except in places remote from London.

Elixir, Radcliffe's. *Prep.* 1. From socotrine aloes, 6 dr.; rhubarb, 1 dr.; cinnamon (cassia), cochineal, and zedoary root, of each, ½ dr.; syrup of buckthorn, 2 fl. oz.; brandy, 1¼ pints; digest 10 days, and strain.

2. As the last, but substituting proof spirit, 1 pint, and water, ¼ pint, for the brandy. Aromatic. stomachic, and aperient.—*Dose*, 1 to 4 dr.; in similar cases to those in which 'DAFFY'S ELIXIR' is taken.

Elixir of Ro'ses. *Syn.* ELIXIR ROSÆ, L. *Prep.* 1. Eau de rose, 2 fl. oz.; spirits of horseradish and scurvy-grass, of each, 1 fl. oz.; otto of roses, 3 drops; camphor and cochineal (both in powder), 12 gr.; powdered sugar-candy, ½ oz.; digest, with frequent agitation, for a week, and after repose decant the clear, and strain through a piece of muslin. Used as an elegant application in scurvy of the gums, and also to perfume the breath.

2. (*Beasley.*) Cinnamon, 3 oz.; ginger, 2 oz.; cloves, 1 dr.; essence of peppermint, 1 oz.; oil of orange peel, 1 dr.; otto of roses, 15 (? 25) drops; rectified spirit, 2½ pints; digest 15 days, and filter. Used as a tooth cosmetic.

Elixir Rubrum. Solution of carmine, 1 dr.; simple elixir, 8 oz. Used as a colouring and flavouring agent.

Elixir Saccharini. (B. P. C.) Saccharin, 480 gr.; sodium bicarbonate, 240 gr.; rectified spirit, 2½ oz.; distilled water, sufficient to make 1 pint. Used for sweetening medicine, or as a substitute for sugar in diabetes.—*Dose*, 5 to 20 minims.

Elixir Sa'crum. Tincture of aloes and rhubarb.

Elixir Salu'tis. *Syn.* ELIXIR OF HEALTH. The compound tincture of senna of old pharmacy. Sea ELIXIR, DAFFY'S.

Elixir of Scam'mony. *Syn.* ELIXIR SCAMMONII, L. *Prep.* (*Guibourt.*) Scammony (pure), 2 dr.; proof spirit, 8 fl. oz.; mix in a suitable vessel, apply heat, set the spirit on fire, and add of sugar, 4 oz.; when the whole is dissolved (melted down), extinguish the flame, and further add of syrup of violets, 2 fl. oz.; mix well, and after sufficient repose decant the clear portion from the dregs. The product should be 12 oz., containing 12 gr. of scammony per oz.—*Dose*, 1 to 2 dessert-spoonfuls in milk or aromatised water; or made into an emulsion with aromatics; in worms, &c.

Elixir Simplex. *Syn.* SIMPLE ELIXIR. (B. P. C.) Take of oil of bitter orange, 30 minims; rectified spirit, 6 fl. oz.; dissolve, and add distilled cinnamon water, 7 fl. oz.; syrup, 7 fl. oz.; mix. Filter through paper moistened with proof spirit and well sprinkled with kaolin, returning the first portions of filtrate until it passes through bright. *Dose*, 20 to 60 minims.

Elixir, Squire's. *Prep.* 1. (*Original Formula.*) Aurum musivum, 3 oz.; opium, 2 oz.; camphor, 1 oz.; cochineal, ½ oz.; sweet fennel, ¼ oz.; tincture of serpentary, 1 pint (old meas.); spirit of aniseed, 1 gall. (old meas.); sugar, 1 lb.; dissolved in water, 1 pint (old meas.); digest 10 days, and filter.

2. Powdered opium, 2 oz.; ginger, red sanders wood, and camphor, of each, 1 oz.; oil of aniseed, ½ oz.; oil of sweet fennel, ½ dr.; tincture of serpentary, 1 pint; proof spirit, 5 pints; water,

1 quart; as last. Stimulant, anodyne, diaphoretic, and pectoral.—*Dose*, 1 to 2 teaspoonfuls; in chest affections, nervous headaches, &c., in the absence of inflammatory symptoms.

Elixir, Stomach'ic. Compound tincture of gentian was formerly so called.

Elixir, Stoughton's. *Prep.* 1. Raisins (stoned and bruised), 1 lb.; gentian root, ¾ lb.; dried orange peel, 6 oz.; serpentary, ¼ lb.; calamus aromaticus, 1½ oz.; cardamoms, ½ oz.; sugar colouring, ½ pint; brandy or proof spirit, 2 galls.; digest a week and strain.

2. Tincture of gentian (compound), and brandy, or proof spirit, of each, 1 quart; tincture of serpentary and syrup of saffron, of each, 1 pint; tinctures of aloes and rhubarb, of each, ¼ pint; bitter almonds (bruised), 8 in number; digest as before.

3. (*Foy.*) Aloes and cascarilla, of each, 1 dr.; rhubarb, 4 dr.; gentian, germander, dried orange peel, and wormwood, of each, 6 dr.; rectified spirit, 32 fl. oz.; as before. Stimulant, tonic, and stomachic.—*Dose*, 20 drops to a teaspoonful.

Elixir, Ton'ic. *Syn.* ELIXIR ROBORANS. See TINCTURE OF CROWN BARK (Comp.) (Ph. Bor. 1847).

Elixir Tonique Antiglaireux de Guillé. A stomachic tonic for diarrhœa. Calumba root, 90 parts; orris root, 60 parts; gentian root, 8 parts; jalap root, 1500 parts; aloes, 13 parts; saffron, 60 parts; sulphate of quinine, 16 parts; tartar emetic, 2 parts; nitre, 16 parts; yellow sandal, 30 parts; syrup prepared from barley sugar, rectified spirit, and water, of each, 11,000 parts. Macerate the drugs in spirit for 24 hours, and dissolve the salts in the water. Filter the liquids, mix and leave for 24 hours, then add the syrup, stand and filter next day (*Reveil* and *Hager*).

Elixir, Tooth. *Syn.* ELIXIR DENTIFRICUM, L. *Prep.* 1. (*Lefandinière's.*) Guaiacum raspings and cloves, of each, 1 oz.; pellitory of Spain and nutmeg, of each, 2 dr.; oil of rosemary, 20 drops; bergamotte, 10 or 12 drops; brandy, 1 quart; macerate a fortnight, and filter.

2. Cinnamon, cloves, and nutmeg, of each, 1 dr.; vanilla, ½ dr.; camphor, 10 gr.; tincture of pellitory, 2 fl. oz.; brandy or proof spirit, ½ pint; digest as before. See ANTI-SCROFULOUS and ROSE ELIXIRS (*above*).

Elixir Valerianatis Ammonici. (*Goddard.*) Valerianic acid, 3 grms. dissolved in 40 grms. distilled water and neutralised with ammonium carbonate. Add this to 35 grms. spirit, 50 grms. syrup, 1 drop bitter almond oil, 2 drops oil of orange peel, 30 grms. diluted bitter almond water, 12 grms. tincture of red sandal, 3 grms. tincture of orange peel, 2 grms. burnt sugar, and filter.

Elixir, Vis'ceral. *Syn.* ELIXIR VISCERALÆ, L. See ELIXIRS, BOERHAAVE'S and HOFFMAN'S (*above*).

Elixir of Vit'riol. 1. The old name for aromatic SULPHURIC ACID (which *see*).

2. (*Mynsicht's.*) See TINCTURE (Acid Aromatic).

3. (Scourer's.) Dilute sulphuric acid, 1 to 5. Used to scour metals.

4. (SWEET E. OF V.; E. VITRIOLI DULCI, L.) The old name for aromatic SPIRIT OF ETHER (which *see*).

5. (*Virgani's.*) *Prep.* From spirit of sulphuric ether, 2 lbs.; aromatic tincture, 3 lbs.

Elixir, Woroneje. Capsicum, 1 oz.; nitre, ½ oz.; sal-ammoniac, 2 dr.; nitro-hydrochloric acid, 2 fl. dr.; vinegar, 1½ pints; native white or rose naphtha, or petroleum, 1½ fl. dr.; olive oil, 1 fl. oz.; oil of peppermint (Mitcham), 15 fl. oz.; strongest rectified spirit, 6 quarts; digest 12 days, with constant agitation, and filter.—*Dose*, 2 teaspoonfuls every 15 minutes; in cholera, diarrhœa, &c.

ELLAGIC ACID. $C_4H_8O_9$. A grey powder formed by the oxidation of gallic acid by arsenic acid, silver oxide, or iodine and water. It occurs in the benzoar stones (an intestinal calculus of the Persian goat), from which it may be obtained by boiling the stones with caustic potash, and adding hydrochloric acid, when ellagic acid is precipitated.

ELM. *Syn.* ULMUS, L. A genus of trees forming the type of the Nat. Ord. ULMACEÆ. The interior bark of the *Ulmus campestris*, or *common small-leaved elm* (*Ulmi cortex*), is officinal in B. P. This substance is demulcent, diaphoretic, and diuretic, and slightly febrifuge, astringent, and tonic. It has been employed in agues, and as a substitute for sarsaparilla in cutaneous eruptions, but is now little used. The leaves of the elm tree are reported to be vulnerary. See DECOCTION and ULMIN.

ELŒSELINUM. See AMMONIACUM.

ELUTRIA'TION. Cleansing by washing. The term is commonly applied to the operation of washing insoluble powders with water, to separate them from foreign matter, or from the coarser portion. It is usually performed by grinding or triturating the mass with a little water until it is reduced to a very fine powder, and suddenly mixing the paste with a large quantity of water, contained in a deep vessel, from which, after the subsidence of the heavier portion, the liquid is poured into another vessel, and allowed to deposit the fine powder it still holds in suspension. When this has taken place, the clear supernatant liquor is decanted, and the sediment drained and dried. The coarse sediment deposited in the first vessel is now submitted to a fresh grinding and diffusion through water, and the entire operation is repeated until the whole of the pulverisable portion is washed over. The proper length of time for the liquid to remain in the first vessel depends solely on the density of the powder and the degree of fineness required in the product; heavy powders subsiding almost immediately, while light ones often take several minutes to deposit the coarser portion. Sometimes 3 or more vessels are employed, and the muddy liquor, after remaining a short time in the first, is poured into the next one, and this, in a short time longer, into the third, and so on, until the last vessel is filled; by this means powders of different degrees of fineness are obtained, that deposited in the last vessel being in the minutest state of division. The elutriated paste or moist powder is then drained, and dried. On the small scale the trituration is performed with a stone and muller, or in a mortar; on the large scale, in a mill, driven by either horse or steam power. Antimony, chalk, bistre, and other pigments, as well as various other substances in-

soluble in or unacted on by water, are commonly obtained in the state of an impalpable powder by elutriation, or 'washing over,' as it is technically called.

EMBALM'ING. *Syn.* MUMMIFICATION. The preservation of the dead bodies of animals. See PUTREFACTION.

EMBLIC MYROBALAN (*Phyllanthus emblica*, Linn.). A moderate-sized tree of the Indian and Burmese forests. The fruits are edible, and are used for preserves, in medicine, and for dyeing and tanning. The wood is durable, and is used for agricultural implements, buildings, furniture, &c.

EMBOSS'ING. The formation of ornamental figures in relief on cloth, leather, paper, and wood, has now been brought to such perfection as to place this species of decoration within the reach of almost every class of society. EMBOSSED CLOTH and PAPER are now employed by the bookbinder to cover even the low-priced volumes that pass through his hands; whilst the EMBOSSED LEATHER that encloses the album or ornaments our furniture frequently bears the richest patterns of the arabesque or moresque. Cloth and paper are usually embossed by machinery; leather and wood more frequently by hand labour.

EMBROCA'TION. *Syn.* EMBROCATIO, L. A fluid medicine for external and local use. Embrocations do not differ materially from liniments and lotions, and are applied in the same manner. (See those preparations, and *below*.)

Embrocation of Cantharides. *Syn.* EMBROCATIO CANTHARIDES. (*Dr Struve*, in *hooping-cough.*) *Prep.* Tartarised antimony, 1 scr.; water, 2 oz.; tincture of cantharides, ½ oz. To be rubbed over the region of the stomach, covering the part afterwards with flannel.

Embrocation, Elliman's. White of egg, 2 parts; turpentine, 8 parts; crude pyroligneous acid, 50 parts; water, 50 parts; spirit (methylated), 60 parts.

Embrocation, Guestonian. *Syn.* EMBROCATIO TEREBINTHINÆ CUM ACIDO, L. *Prep.* (*Dr Paris.*) Oil of turpentine and olive oil, of each, 1½ oz.; dilute sulphuric acid, 3 fl. dr.; agitate together until mixed. Used in rheumatism, &c.

Embrocation, Lynch's. Olive oil (coloured with alkanet root), 5 fl. oz.; oils of amber, rosemary, and turpentine, of each, 1 dr. In bruises, rheumatism, &c.

Embrocation, Roche's. *Prep.* 1. (*Dr Paris.*) Olive oil, mixed with half its weight of the oil of cloves and amber.

2. Olive oil, 2 oz.; oil of amber, 1 oz.; oils of cloves, and lemons, of each, 1 dr. for hooping-cough.

Embrocation, Ward's. See ESSENCE.

EMBROID'ERY. Gold and silver fancy work of this description may be cleaned with a little spirit of wine, either alone or diluted with an equal weight of water. Gin is frequently used for the same purpose. The common practice of using alkaline or acid liquors is very injurious, and frequently destroys the beauty of the articles instead of cleaning them.

EM'ERALD. *Syn.* SMARAGDUS, L.; EMERAUDE, Fr. This beautiful deep-green gem ranks next to the diamond in value. The finest are brought from Peru, but fair varieties are found in Bavaria, Siberia, and India. A fine emerald weighing 4 or 5 gr. is worth as many pounds; one of 10 gr., about £2 per gr.; one of 15 gr., £3 to £4 per gr.; and so on in proportion to the increase in size. One of 24 gr., if of pure water, is worth about £100. According to the analysis of Vauquelin, the purest specimens consists of 65 parts silica, 14 alumina, 13 glucina, 2·56 lime, and 3·50 oxide of chromium, to which last the gem owes its rich green colour. See BERYL, GEMS, PASTES, &c.

Emerald Green. See GREEN PIGMENTS.

EMERY is an impure, amorphous, compact, and opaque variety of corundum, and consists of alumina, with a small percentage of silica and peroxide of iron. It occurs in Spain, the isles of Greece, and other localities, and derives its name from Cape Emeri, in the island of Naxos. Its hardness is so great, that it scratches and wears down nearly all minerals except the diamond; hence the use of its powder for cutting and polishing glass and various other hard substances for commercial purposes, the lumps of emery, as taken from the mine, are broken into pieces about the size of a hen's egg, which are then crushed under stampers, similar to those used for pounding metallic ores. The coarse powder is then sifted through sieves covered with wire-cloth of different degrees of fineness, by which it is sorted into different sizes. In this state it forms the emery of the shops, or flour emery. For delicate purposes, it is afterwards prepared by elutriation.

Emery Cakes are formed by melting emery flour with a little beeswax, and after thorough admixture, forming it into solid lumps of suitable sizes. Used to dress the edges of buff and glaze wheels.

Emery Cloth is prepared by brushing the surface of thin cotton cloth over with liquid glue, and sifting the emery powder over the surface while still warm.

Emery Paper is made in the same way as emery cloth. Both are used either with or without oil, in the same way as glass paper.

Emery Sticks are made of pieces of wood in the same way, and are used for the same purposes, as emery paper.

Emery Stones are formed of emery, of the requisite coarseness, mixed with about half its weight of good Stourbridge loam, and water q. s. to make a stiff paste, which is forced into metallic moulds by a powerful press. The pieces, when thoroughly dry, are exposed in a muffle for a short time to a temperature just under a full white heat. In this way 'discs' and 'laps' are generally made. For 'wheels,' only 1-4th of loam is used. Another method, applicable for 'cutting stones' generally, is to press the flour emery, previously moistened with water, into moulds, with strong pressure, as before, without any other addition, and then to fire it at nearly a full white heat.

EMETIA. *Syn.* EMETIN, EMETINA. A basic or alkaloidal body, existing in and forming the active principle of ipecacuanha.

Prep. 1. (Medicinal, EMETIC EXTRACT). *a.* Ipecacuanha (in coarse powder) is digested first in ether, and then in rectified spirit for 3 or 4

days; the alcoholic tincture is next expressed and evaporated (distilled) to dryness; the residuum is dissolved in distilled water, and the solution precipitated with acetate of lead; the precipitate is then diffused through distilled water, in a tall glass vessel, and sulphuretted hydrogen is passed through it, to throw down the lead; after which the liquor is decanted, filtered, evaporated to the consistence of a thick syrup, and spread in a thin layer on warm plates of glass, and allowed to dry in a current of warm air, or by a gentle heat in a stove. The maceration in ether is frequently omitted.

b. Ipecacuanha, 1 part; rectified spirit (·835), 7 parts; make a tincture, distil off the spirit, dissolve in cold distilled water, 5 parts; filter the solution, and evaporate, &c., as before. Inferior to the last.

c. (P. Cod.) As the last, nearly.

Obs. Medicinal or impure emetia is brownish, red, deliquescent, and emetic in doses of $\frac{1}{4}$ to $\frac{1}{2}$ gr.

2. (Pure.) *a.* Ipecacuanha (in coarse powder), 1 part, is digested for 24 hours in distilled water, 10 parts; together with calcined magnesia, added in slight excess; the deposit is then thrown on a filter, washed carefully with very cold water, and dried; it is next dissolved in rectified spirit and neutralised with dilute sulphuric acid; the filtered solution is decoloured with animal charcoal, again filtered, and again precipitated by digestion with magnesia; the last deposit forms a colourless solution with rectified spirit, which, by gentle evaporation, gives up its emetia as a yellowish-white pulverulent mass, which may be rendered perfectly white by redissolving it in alcohol, &c., as before. The process is rendered easier by first digesting the powdered ipecacuanha in ether.

b. (P. Cod.) Alcoholic extract of ipecacuanha, 1 part; water, 10 parts; dissolve, filter; add calcined magnesia, 1 part; evaporate to dryness, wash the product on a filter with very cold water, 5 parts; dry it again, and dissolve it in boiling alcohol; evaporate the filtered tincture to dryness, redissolve the residuum in a little water, acidulate (slightly) with dilute sulphuric acid, decolour with animal charcoal, filter, precipitate with liquor of ammonia, and dry the precipitate by a gentle heat.

c. (Ph. Suec. 1845.) Powdered ipecacuanha, 1 part; water, acidulated with sulphuric acid, 6 parts; digest, filter; add lime, 1 part, and evaporate to dryness over a water-bath; the residuum is then exhausted with boiling rectified spirit, and otherwise treated as in the last formula.

Prop., &c. Pure emetia is white, pulverulent, inodorous, and bitter; fusible at 122° F.; very soluble in alcohol and boiling water, but only slightly so in ether, oils, and cold water. It restores the blue colour of reddened litmus, and partially neutralises the acids, forming scarcely crystallisable salts. It is reddened by nitric acid, and this red colour is deepened by ammonia. Tincture of iodine produces a reddish precipitate in an alcoholic solution of emetia. With tincture of galls this solution behaves like morphia; but unlike the last substance, the salts of iron produce no change of colour in it. These reactions, combined with its emetic properties, are sufficient for its identification.—*Dose.* White and pure emetia is emetic in doses of $\frac{1}{20}$ to $\frac{1}{16}$ gr. The large doses ordered in certain pharmaceutical compilations, evidently in error of the difference between the strengths of the pure and the impure or medicinal emetia, have, in several cases which have been reported on, produced very serious consequences.

The 'Journal de Pharmacie et de Chemie,' for September, 1875, contains a new process for the extraction of emetia, by M. A. Glenard. This process is based upon the combined use of lime and ether. It consists in treating with ether a suitably prepared powder, or an extract of ipecacuanha and lime, or the precipitate formed upon adding an excess of lime to a solution obtained by treating ipecacuanha in the cold with water acidulated by sulphuric acid. Either of these mixtures, or the precipitate, when treated with ether, will yield all the alkaloid it contains.

The alkaloid may be obtained from the ethereal solution by distilling it to dryness, and treating the residue with acidulated water, or by at once shaking the solution with acidulated water. A more or less acid aqueous liquid is thus obtained, which upon the addition of ammonia, yields the emetine almost colourless, and much more pure than that produced by the process ordinarily employed.

Preparation of Crystallised Hydrochlorate and Pure Emetine. When water, acidulated with hydrochloric acid, is employed to remove the emetine from the ether, an acid solution is obtained, which, when sufficiently concentrated by evaporation, forms a nearly colourless, solid, crystalline mass. This mass is formed of extremely delicate needles, formed in bundles that radiate around a central point, and form small spheres with an embossed surface, resembling mulberries in appearance. Upon pressing these crystals in a cloth the more or less coloured mother-liquid runs off, and the crystals redissolved in water give a colourless solution, from which a fresh crystallisation of perfectly pure hydrochlorate of emetine can readily be obtained.

The production of this crystallised hydrochlorate of emetine is worthy of notice, since it does not accord with what has been stated by different authors, who have all considered emetine to be incapable of forming crystallisable salts. It is especially interesting in that it furnishes a convenient and certain method of obtaining perfectly pure emetine, for which it is only necessary to precipitate a solution of the hydrochlorate with an alkali. But it is important to observe that ammonia does not precipitate all the emetine of the hydrochlorate, and that the precipitate is less in proportion as the salt is more acid.

It might appear from this that emetine is soluble in hydrochlorate of ammonia. But the author finds that it is the result of a decomposing action exercised by the emetine upon the hydrochlorate of ammonia, as is shown by the following two experiments:—If a little dry powdered emetine be placed in a glass containing a solution of hydrochlorate of ammonia, it may be observed to agglomerate and become transformed into a soft resinoid mass; at the same time the disengage-

ment of ammonia may be recognised, and the resinoid mass gradually undergoes a kind of metamorphosis, and becomes white and crystalline. Again, if emetine in powder be suspended in water, and a solution of hydrochlorate of ammonia be gradually added, the emetine is dissolved, and upon evaporation of the solution crystals of double hydrochlorate of emetine and ammonia are obtained.

The author believes the decomposition of hydrochlorate of ammonia by an organic alkali to have been hitherto unobserved. It does not appear, however, that emetine is alone in this action, as the author has observed that quinine, under similar conditions, behaves in the same manner.

Zinoffsky ('Jour. de Pharm. d'Anvers,' xxix, 490) gives the following process for the quantitative determination of emetia:—Treat 15 grms. of powdered ipecacuanha with alcohol of 85% acidified with a few drops of sulphuric acid, so as to form a volume of 150 c.c. Filter, and after expelling the alcohol from 100 c.c. of the liquid by distillation, add to the residue a titrated solution of iodo-hydrargyrate of potassium until a filtered portion ceases to be affected by this reagent. The number of c.c. of iodo-hydrargyrate multiplied by 0·0189 (0·0001 of the equivalent of emetine) gives the quantity of emetine contained in 10 gr. of the root.

A normal solution of iodo-hydrargyrate is obtained by mixing aqueous solutions of 13·546 grms. of bichloride of mercury and 49·8 of iodide of potassium, adding water to make 1 litre. 1 c.c. of this solution precipitates 0·0001, or 0·00005 of an equivalent of alkaloid.

Wine of ipecacuanha can be titrated by the same process.

Composition of Emetine and its Hydrochlorate. These substances, dried at 110° C., gave upon analysis results corresponding with the following centesimal composition:

	Emetine.	Hydrochlorate of Emetine.
Carbon	72·25	63·00
Hydrogen	8·61	8·15
Nitrogen	5·36	4·75
Oxygen	13·78	11·64
Chlorine		12·46

From these figures the author has constructed the following formulæ:

$$\underbrace{C_{30}H_{22}NO_4}_{\text{Emetine.}} \qquad \underbrace{C_{30}H_{22}NO_4HCl}_{\text{Hydrochlorate of Emetine.}}$$

Preparation and Composition of Emetine (*J. Lefort* and *F. Wurtz*, 'Comptes Rendus,' lxxxiv, 1299). When ipecacuanha is dissolved in water, and a concentrated solution of potassium nitrate added, a thick mass is produced, consisting of emetine nitrate. It is washed with water, dissolved in alcohol, and the solution poured into milk of lime. The mixture is evaporated to dryness, and digested with ether, which dissolves out the emetine, leaving it as a yellowish mass on evaporation. On dissolving this mass in sulphuric acid, and pouring the solution into dilute ammonia, the alkaloid is obtained as a white precipitate, which is dissolved in alcohol, from which it separates in minute radiate groups of needles. By analysis it gave numbers leading to the formula $C_{28}H_{40}N_2O_3$. [Note by the translator ('Jour. of Chem. Soc.'): "This is printed $C_{28}N_2H_{40}O_5$ in the formula for emetine nitrate, and as no data are given, it is impossible to tell which are correct."]

Pure emetine nitrate was prepared, and was found to have the formula $C_{28}N_2H_{40}O_5NOH$; this, in conjunction with Glenard's results, shows that emetine does not form basic salts.

EMET'ICS. *Syn.* VOMITS, ANACATHARTICS; ANACATHARTICA, EMETICA, VOMITORIA, L. Medicines which induce vomiting. The principal emetics are ipecacuanha and tartarised antimony, and their preparations; and the sulphates of zinc and copper. Of these the first is commonly employed either in substance or infused in wine (ipecacuanha wine), when it is merely wished to evacuate the contents of the stomach, when that organ is in a disordered state or overloaded with food; and is the one most adapted in ordinary cases for children and females. Tartar emetic (tartarated antimony) (dissolved in water) and antimonial wine, either alone or combined with ipecacuanha, are preferable at the commencement of fevers and other inflammatory disorders, in consequence of the nausea, relaxation, and depression of the muscular power and circulation which commonly follow their use. When poison has been taken, sulphate of zinc is generally preferred as an emetic, on account of the promptness and completeness of its action, and its effects ceasing as soon as it is ejected from the stomach. Sulphate of copper is employed in the same cases as sulphate of zinc, but its action is more violent and disagreeable, whilst its intense metallic taste is a great objection to its use. 25 to 30 gr. of either of the above sulphates are dissolved in 3 or 4 fl. oz. of warm water, and a fourth of the solution is given every 10 minutes, until copious vomiting ensues. In the absence of other substances, when an immediate emetic is required, a teaspoonful of flour of mustard (an article always at hand), stirred up with ½ pint of warm water, and drunk at a draught, will generally act easily and effectively, and relieve the stomach before other remedies can be obtained and applied.

The operation of emetics is powerfully promoted by drinking copiously of diluents, especially of warm or tepid water. The latter, in fact, is itself an emetic when taken in quantity. Its use will also prevent that dreadful straining and retching which makes emetics so much dreaded by the nervous and delicate.

Emetics should be avoided in plethoric habits, in hernia, pregnancy, and whenever visceral inflammation is suspected. They should also be given with great caution to young children and females, and to the nervous and delicate. In such cases, wine or powder of ipecacuanha should alone be employed.

Emetic Cups. *Syn.* ANTIMONIAL CUPS; POCULA EMETICA, CALICES VOMITORII, L. Small cups made of metallic antimony. Wine left in them for 10 or 12 hours becomes emetic.

Emetic Tartar. See ANTIMONY, TARTARATED.

EM'ETINE. See EMETIA.

EMMEN'AGOGUES. *Syn.* EMMENAGOGA, L. Medicines which are considered to have the power

of promoting the menstrual discharge when either retained or suspended. There are, probably, few remedies which exert this specific power on the uterus, the majority of reputed emmenagogues acting rather by their influence on the system generally, or on parts contiguous to the uterus, than in the uterus itself. Among the substances usually arranged under this class are—aloes, black hellebore, birthwort, borax, cubebs, ergot, gamboge, gin, iodide of potassium, iodine, madder, mercurials, the peppers, rue, savine, stimulants (generally), stimulating diuretics, stinking goosefoot, stinking orache, wine, &c.

Of the above, ergot and madder are the only articles which exercise a direct power on the uterus, and that rather in increasing its expulsive energy than in promoting the menstrual function, though they are advantageously employed for the latter purpose. Several of the other substances named are drastic purgatives, or possess cerebro-spinal properties or local powers of irritation, by which they increase the pelvic circulation or produce excitement in the neighbouring parts, in many cases of a dangerous and irreparable character. Hence many writers on pharmacology deny the existence of emmenagogues.

In the majority of cases the restoration of the discharge is rather attributable to a proper regulation of the system than to any specific power in the medicine administered.

EMODIN. A crystalline principle found in the bark of black alder, also known as frangula bark.

EMOL'LIENTS. *Syn.* Emollienta, L. In *pharmacy* and *therapeutics*, demulcents of an oleaginous, saponaceous, or emulsive character, applied to surfaces (generally external), to soften and relax the fibres. See Demulcents.

EMUL'SIN. *Syn.* Synaptase. An azotised substance, forming a large proportion of the white pulp of both bitter and sweet almonds. It is yellowish white, soluble in cold water, and coagulated by heat and alcohol. Its most remarkable property is its action on amygdalin, by which the volatile oil of almonds and hydrocyanic acid, with other products, are formed. It has never been obtained in a state of purity.

EMULSINES. See Emulsion.

EMULSION. *Syn.* Emulsio. An emulsion is a preparation wherein finely divided and insoluble matter is held in suspension by means of an emulsifying agent; the suspension should be of such a character that, after standing some days, the emulsified matter does not coalesce. Amongst pharmacists the term emulsion is usually confined to the fine division and permanent suspension of oils, resins, and gum-resins; the word, however, has obtained a much wider meaning, and now includes all cases of fine division and lengthened suspension. The body emulsified is the one present in smallest quantity; so that oil can be made to emulsify water, and water oil. In *photography*, emulsions of bromide and iodide of silver are employed, the suspending agent being gelatin. Milk is a natural emulsion, its whiteness being due to finely divided fat, held in suspension by means of casein and milk-sugar.

The chief emulsifying agents are the powders and mucilages of the gums of acacia and tragacanth, yelk of egg, powdered sweet almonds, tinctures of senega and quillaia. Solutions of potash and soda are sometimes spoken of as emulsifying agents, but with oils and resins they form soaps, which are not true emulsions.

The theory of emulsification as regards fluids is that each minute particle becomes surrounded with an envelope of mucilage or similar matter, thus forming a number of closed capsules, the cases of which, though in contact with each other, are strong enough to resist any attempt of the fluid to escape.

An excellent method of preparing emulsions of resins and gum-resins is to put the article into a marble or wedgwood mortar, and to pour over it about 4 times its weight of rectified spirit, which is then to be ignited, and the mixture triturated until an equal consistence is obtained. The liquid is then to be added gradually, and the whole patiently triturated or shaken until cold. Yelk of egg or mucilage may be added to the fluid resin or gum-resin if desired, as in the common method, but an excellent emulsion may be made without them.

The presence of soluble salts in an emulsion is apt to occasion the separation of the oleaginous portion. Spirit produces the same effect in those which are made with yelk or mucilage; and acids in those made with an alkali. The addition of these substances to emulsions should be therefore avoided as much as possible. Emulsions of wax, spermaceti, oil of turpentine, and balsam of copaiba are the most readily and completely formed with yelk of egg. Volatile oils are more readily made into emulsions if mixed with an equal volume of some simple fixed oil before proceeding to operate on them. Scammony is generally formed into an emulsion with milk; and resin of jalap, with almonds and water.

In a paper read before the American Pharmaceutical Association by Mr Gregory, the author recommends the use of powdered gum instead of mucilage in the preparation of emulsions. He thinks that 3 dr. of acacia in fine powder are necessary to emulsify 1 oz. of any of the volatile oils, and that a little less (about 2 dr.) will answer for the fixed oils and balsams, and that to this quantity of gum $4\frac{1}{2}$ dr. of water must be added (no more and no less), and that either the water or the oil may be added first to the gum, but it is quickest to add the oil the first; and well triturate before adding the water. Less gum can be made to yield a good result by a careful operator, but, as a general practical working rule, it may be said that 3 dr. are necessary for 1 oz. of oil.

The following formulæ for certain emulsions are merely given here for examples. Various others will be found under Lotion, Mixture, Wash, &c.

Emulsion of Al'monds. *Syn.* Milk of almonds, Almond mixture; Emulsio amygdalæ, Mistura a., L. *Prep.* 1. Blanched almonds, 1 oz.; beat them to a smooth paste; add, gradually, water, $\frac{1}{2}$ pint; and when the whole is thoroughly incorporated, strain through a piece of gauze.

2. As the last, adding sugar, 1 oz.; or syrup (either simple or flavoured), $1\frac{1}{2}$ fl. oz. See Emulsion of Oil of Almonds (*below*).

Emulsion of Assafœt'ida. *Syn.* Emulsio

ASSAFŒTIDÆ, MISTURA A., L. *Prep.* (*Duclow.*) Assafœtida, 1 oz.; powdered gum, 2 oz.; oil of almonds, 3½ fl. oz.; water, 6 fl. oz. Antispasmodic.—*Dose*, 1 to 2 tablespoonfuls; in hysterical affections, &c.

Emulsion of Balsam of Copaiba. Take of balsam of copaiba, 3 dr.; powdered gum-acacia, 3 dr.; simple syrup, 6 dr.; water to 6 oz. Mix the powder with the balsam, add 6 dr. of water, stir till the emulsion is formed; gradually add the remainder of the water and syrup.

Emulsion of Cam'phor. *Syn.* EMULSIO CAMPHORÆ, E. CAMPHORATA, MISTURA CAMPHORÆ (Ph. E.), L. *Prep.* 1. (Ph. Castr. Ruth. 1840.) Camphor, ½ dr.; triturate with milk, ½ fl. oz., gradually added; then further add of water, 7½ fl. oz.

2. (Ph. E.) Camphor, 20 gr.; lump sugar, ½ oz.; triturate together, and add of blanched almonds, ½ oz.; again triturate, then gradually add of water, 1 pint. Stimulant, antispasmodic, and diaphoretic.—*Dose*, 1 to 2 fl. oz.

Emulsion of Castor Oil. Castor oil, 1 oz.; powdered gum-acacia, 3 dr.; essential oil of almonds, 2 minims; saccharin, 1 gr.; water to make 4 oz. Mix the oils with the gum and saccharin in a dry mortar, add 4 dr. of water, stirring till the emulsion is formed; add water to make 4 oz. (*Gerrard*).

Emulsion of Chian Turpentine. Ethereal solution of Chian turpentine (1 in 3 of ether), ½ oz.; mucilage of tragacanth, 4 oz.; syrup, 1 oz.; sublimed sulphur, 40 gr.; water to 16 oz.

This preparation is strongly recommended by Professor Clay as a remedy for cancer.—*Dose*, ½ to 2 oz. three times a day.

Emulsion of Cod-liver Oil. 1. Cod-liver oil, 4 oz.; powdered gum-acacia, 1 oz.; oil of cassia, 4 minims; oil of almonds, 4 minims; saccharin, 2 gr.; water to make 8 oz. Mix the oils with the gum and saccharin in a dry mortar, add 2 oz. of water in one volume, stirring till the emulsion is formed; finally add water to make 8 oz. (*Gerrard*).

2. Cod-liver oil, 8 oz.; yelks of 2 eggs; powdered tragacanth, 16 gr.; elixir of saccharin, 1 dr.; simple tincture of benzoin, 1 dr.; spirit of chloroform, 4 dr.; essential oil of almonds, 8 minims; distilled water, enough to produce 16 oz.

Measure 5 oz. of the water, place the tragacanth in powder in a dry mortar, and triturate with a little of the cod-liver oil, then add the yelks of eggs, and stir, adding water as the mixture thickens. When of a suitable consistence add the remainder of the oil and water alternately, with constant stirring. Transfer to a pint bottle, add the remaining ingredients, and make it measure 16 fl. oz. (B. P. C.).

Emulsion of Cod-liver Oil with Hypophosphites. To 8 oz. of cod-liver oil emulsion (*Gerrard's* formula), add 64 gr. of calcium hypophosphite, 48 gr. of sodium hypophosphite, and 32 gr. of potassium hypophosphite.—*Dose*, 2 to 8 dr.

Emulsion of Copai'ba. *Syn.* EMULSION OF CAPIVI; EMULSIO COPAIBÆ, MISTURA C., L. *Prep.* 1. Balsam of copaiba and syrup of orange peel, of each, 2 oz.; yelks of 5 eggs; milk, 14 oz.

2. (*Beral.*) Copaiba and mucilage, of each, 2 oz.; water, 12 fl. oz.—*Dose*, ½ to 1 oz., 2 or 3 times a day; where the use of copaiba is indicated.

Emulsion of Cubebs. *Syn.* EMULSIO CUBEBÆ. (*Dublanc.*) *Prep.* Essence of cubebs, 4 oz.; mucilage, 4 oz. Mix them.

Emulsion of Gum. *Syn.* EMULSIO ACACIÆ, MISTURA ACACIÆ (Ph. E.), L. *Prep.* From sweet almonds (blanched), 10 dr.; white sugar, 5 dr.; mucilage, 3 fl. oz.; water, 1 quart. Demulcent. In coughs, &c., *ad libitum.*

Emulsion of Indian Hemp. *Syn.* EMULSIO CANNABIS INDICÆ. (*Mr Bromfield.*) *Prep.* Rub 1 scr. of extract of Indian hemp in warm water with 1 fl. dr. of olive oil; then add gradually, still triturating the mixture, 4 dr. of mucilage of acacia and 7½ oz. of distilled water.

Emulsion of Oil of Almonds. *Syn.* EMULSIO OLEI AMYGDALÆ, L. *Prep.* From oil of almonds, 3 dr.; thick mucilage and simple syrup, of each, 5 dr.; rose-water, 1 fl. oz.; distilled water, 3 to 4 fl. oz. An elegant and efficient substitute for almond milk. See EMULSION OF ALMONDS (*above*).

Emulsion, Pancreatic. See PANCREATIN.

Emulsion of Peru'vian Balsam. *Syn.* EMULSIO BALSAMICA, E. BALSAMI PERUVIANI, L. *Prep.* 1. As emulsion of copaiba.

2. (Hosp. F.) Balsam of Peru, ½ oz.; oil of almonds, 6 dr.; powdered gum, 1 oz.; triturate together, and add, gradually, rose-water, 4 fl. oz. —*Dose*, 1 or 2 tablespoonfuls; in old asthmas, chronic coughs, winter coughs, &c.

Emulsion of Poppies. *Syn.* EMULSIO PAPAVERIS. *Prep.* Poppy seeds, 2 dr.; water, 8 oz. Make into an emulsion and strain.

Emulsion of Resin of Jalap. *Syn.* EMULSIO PURGANS CUM RESINÆ JALAPÆ. (Par. Pharm.) *Prep.* Resin of jalap, 8 gr.; white sugar, 1 oz.; orange-flower water, 2 dr.; water, 4 oz. Triturate the resin with a little of the sugar, add gradually half the yelk of an egg, triturate for a long time, then add gradually the rest of the sugar and the water.

Emulsion of Scam'mony. *Syn.* EMULSIO SCAMMONII, MISTURA S. (Ph. E.), L. *Prep.* 1. (Ph. E.) Resin of scammony, 7 gr.; new milk, 3 fl. oz. For a dose.

2. (*Planche.*) Aleppo scammony, 7 gr.; sugar, 2 dr.; new milk, 3 fl. oz.; cherry-laurel water, 5 drops. For a dose. Purgative; in torpor of the intestines, dropsy, worms, &c. The formula of the Paris Codex is similar.

Emulsion of Spermace'ti. *Syn.* EMULSIO CETACEI, MISTURA C., L. *Prep.* As emulsion of wax. Demulcent.

Emulsion of Turpentine. *Syn.* EMULSIO TEREBINTHINÆ, MISTURA T., L. *Prep.* 1. Chio turpentine, 2 dr.; white sugar, 1 oz.; yelk of 1 egg; milk of almonds, 4 fl. oz. In gleets.—*Dose*, 2 tablespoonfuls, 3 or 4 times a day.

2. (*Clossius.*) Venice turpentine, 1½ dr.; yelk of 1 egg; peppermint water, 4½ fl. oz. (see *below*).

Emulsion of Turpentine Oil. Oil of turpentine, 4 dr.; powdered gum, 2 dr.; syrup, 2 dr.; water to 2 oz. Mix the powder with the oil, add ½ oz. water, stir till the emulsion is formed, then add the rest of the water and syrup.

ENAM'EL. A species of vitreous varnish, coloured with metallic oxides, applied in a thin stratum to brightly polished metallic surfaces (copper or gold), on which it is fused by the flame of a lamp urged by the blowpipe, or by the heat of a small furnace.

The basis of all enamels is a highly transparent and fusible gloss, called 'frit,' 'flux,' or 'paste,' which readily receives a colour on the addition of metallic oxides. It may be made by one or other of the following formulæ:

Prep. 1. Red-lead, 16 parts; calcined borax, 3 parts; powdered flint glass, 12 parts; powdered flints, 4 parts; fuse in a Hessian crucible for 12 hours, then pour it out into water, and reduce it to a powder in a biscuit-ware mortar.

2. Tin, 3 parts; lead, 10 parts; mix, calcine in an iron pot at a dull cherry-red heat, and scrape off the oxide as it forms, observing to obtain it quite free from undecomposed metal; then reduce it to fine powder by grinding and elutriation. In this state it is known among enamellers as 'flux' or 'calcine.' Four parts of this 'calcine' are next mixed with an equal weight of pure sand or powdered flints, and 1 part of sea-salt, or other alkaline matter; the mixture is then partially fused in a Hessian crucible, by which it undergoes semi-vitrification.

3. (*Chaptal.*) Lead and tin, equal parts; calcine as above, and take off the mixed oxides or 'calcine' and ground flints, of each, 1 part; pure carbonate of potash, 2 parts; and proceed as before.

4. (*Wynn.*) Flint glass, 3 oz.; red-lead, 1 oz.; as last.

5. (*Wynn.*) Red-lead, 18 parts; borax (not calcined), 11 parts; flint glass, 16 parts; as last.

6. (*Wynn.*) Powdered flints, 10 parts; nitre and white arsenic, of each, 1 part; as last.

Obs. The precise qualities of the products of the above processes depend greatly upon the duration and degree of heat employed. By increasing the quantity of sand, glass, or flux, the enamel is rendered more fusible, and the opacity and whiteness is increased by the addition of oxide of tin. The use of borax should be avoided, or it should be used sparingly, as it is apt to make the enamel effloresce and lose colour.

Enamel, Black. *Prep.* 1. Calcined iron (protoxide), 12 parts; oxide of cobalt, 1 part; mix, add an equal weight of white flux, and fuse as before.

2. (*Clouet.*) Pure clay, 3 parts; protoxide of iron, 1 part. A fine black.

3. Peroxide of manganese, 3 parts; zaffre, 1 part; mix, and add it, as required, to white flux.

Enamel, Blue. *Prep.* 1. White 'frit' or 'flux,' coloured with oxide of cobalt.

2. Sand, red-lead, and nitre, of each, 10 parts; flint glass or ground flints, 20 parts; oxide of cobalt, 1 part, more or less, depending on the desired depth of colour.

Enamel, Brown. *Prep.* 1. Manganese, 5 parts; red-lead, 16 parts; flint powder, 8 parts; as before.

2. (*Wynn.*) Manganese, 9 parts; red-lead, 34 parts; flint powder, 16 parts.

3. Red-lead and calcined iron, of each, 1 part; antimony, litharge, and sand, of each, 2 parts. To be added in any required proportion to white 'frit,' according to the colour desired. A little oxide of cobalt or zaffre is frequently added to alter the shade.

Enamel, Green. *Prep.* 1. 'Flux' or 'frit,' 2 lbs.; black oxide of copper, 1 oz.; as before.

2. As the last, but adding red oxide of iron, ½ dr. Less decisive.

3. Copper dust and litharge, of each, 5 oz.; nitre, 1 oz.; sand, 4 oz.; 'flux' or 'frit,' q. s.

4. From transparent 'frit,' any quantity; oxide of chromium, q. s. to colour. Colour superb; it will stand a great heat; in common hands, however, it frequently turns on the dead-leaf tinge.

5. Transparent 'flux,' 5 oz.; black oxide of copper, 20 to 40 gr.; oxide of chromium, 2 gr. Resembles the emerald.

6. From blue and yellow enamel mixed in the required proportion.

Enamel, Ol'ive. *Prep.* Blue enamel, 2 parts; black and yellow enamel, of each, 1 part. See ENAMEL, BROWN.

Enamel, Or'ange. *Prep.* 1. Red-lead, 12 parts; red sulphate of iron and oxide of antimony, of each, 1 part; flint powder, 3 parts; calcine together, powder, and melt with 'flux,' 50 parts.

2. (*Wynn.*) Red-lead, 12 parts; oxide of antimony, 4 parts; flint powder, 3 parts; red sulphate of iron, 1 part; calcine, then add 'flux,' 5 parts, to every 2 parts of this mixture.

Enamel, Pur'ple. *Prep.* 1. 'Flux' or 'frit,' coloured with oxide of gold, purple precipitate of Cassius, or peroxide of manganese.

2. Sulphur, nitre, green vitriol, antimony, and oxide of tin, of each, 1 lb.; red-lead, 60 lbs.; mix, fuse, cool, powder, and add rose copper (red oxide), 19 oz.; zaffre, 1 oz.; crocus martis, 1½ oz.; borax, 3 oz.; and of a compound formed of gold, silver, and mercury, 1 lb.; fuse, stirring the melted mass with a copper rod all the time; then place it in crucibles, and submit them to the action of a reverberatory furnace for 24 hours. This is said to be the purple enamel used in the mosaic pictures in St Peter's at Rome.

Enamel, Red. *Prep.* 1. 'Paste' or 'flux,' coloured with the red oxide or protoxide of copper. Should the colour pass into the green or brown, from the partial peroxidation of the copper, from the heat being raised too high, the red colour may be restored by the addition of any carbonaceous matter, as tallow, or charcoal.

2. By tingeing the glass or 'flux' with the oxide or salts of gold, or with the purple precipitate of Cassius. These substances produce shades of red, inclining to crimson or purple of the most exquisite hue. The enamel often comes from the fire quite colourless, and afterwards receives its rich hue at the lamp.

3. (*Wynn.*) Sulphate of iron (calcined dark), 1 part; a mixture of 6 parts of 'flux' (No. 5), and 1 of colcothar, 3 parts. Dark red.

4. (*Wynn.*) Red sulphate of iron, 2 parts; 'flux' (No. 1), 6 parts; white-lead, 3 parts. Light red.

Enamel, Rose-col'oured. *Prep.* Purple enamel (or its elements), 3 parts; 'flux,' 90 parts; mix,

and add silver leaf or oxide of silver, 1 part, or less.

Enamel, Transpa″rent. The 'frit' or 'flux' described *above.*

Enamel, Vi′olet. *Prep.* 1. Purple enamel, 2 parts; red enamel (No. 2), 3 parts; 'frit,' 6 parts.

2. Saline or alkaline 'frit' or 'flux,' any quantity; peroxide of manganese, q. s. to colour. As the tint depends on the metal being at the maximum of oxidation, contact with oily or carbonaceous substances should be particularly avoided.

Enamel, White. *Prep.* 1. 'Calcine' (from 2 parts of tin and 1 part of lead), 1 part; fine crystal glass or 'frit,' 2 parts; manganese, a few grains; powder, mix, melt, and pour the fused mass into clean water; again powder and fuse, and repeat the whole process 3 or 4 times, avoiding contamination with smoke, dirt, or oxide of iron. A fine dead white.

2. Washed diaphoretic antimony, 1 part; fine glass (free from lead), 3 parts; mix, and proceed as before. Very fine.

3. Lead, 30 parts; tin, 33 parts; calcine as before; then fuse 50 parts of this 'calcine' with an equal weight of flints, in powder, and 100 parts of salt of tartar. A fine dead white enamel.

Obs. For white enamel, the articles must be perfectly free from foreign admixture, as this would impart a colour. When well managed, either of the above forms will produce a paste that will rival the OPAL.

Enamel, Yellow. Superior yellow enamels are less easily produced than those of most other colours; they require very little flux, and that mostly of a metallic nature. The following come highly recommended by experienced artists:

Prep. 1. From 'frit' or 'flux,' fused with oxide of lead, and a little red oxide of iron.

2. Lead, tin, ashes, litharge, antimony, and sand, of each, 1 oz.; nitre, 4 oz.; mix, fuse, and powder; and add the product to 'flux' or 'frit,' q. s.

3. White oxide of antimony, alum, and sal-ammoniac, of each, 1 part; pure carbonate of lead, 1 to 3 parts, or q. s. (all in powder); mix, and expose them to a heat sufficiently high to decompose the sal-ammoniac. Used as the last. Very bright coloured.

4. (*Wynn.*) Red-lead, 8 oz.; oxide of antimony and tin, calcined together, of each, 1 oz.; mix, and add of 'flux' (No. 5), 15 oz.; mix well and fuse.

5. Pure oxide of silver added to the metallic 'fluxes.' The salts of silver are also used, but are more difficult to manage. If a thin film of oxide of silver be spread over the surface of the enamel to be coloured, exposed to a moderate heat, then withdrawn, and the film of reduced silver on the surface removed, the part under will be found tinged of a fine yellow (*Clouet*).

ENAMELLING OF CAST IRON. Wagner in his 'Chemical Technology' gives the following account of this process: The surface of the cast iron to be enamelled is first carefully cleaned by scouring with sand and dilute sulphuric acid; next a somewhat thickish magma, made of pulverised quartz, borax, feldspar, kaolin, and water, is brushed over the clean metallic surface as evenly as possible, and immediately after a finely powdered mixture of feldspar, soda, borax, and oxide of tin is dusted over, after which the enamel is burnt in by the heat of a muffle. In France an enamel is applied which consists of 130 parts of flint glass, 20½ parts of carbonate of soda, and 12 parts of boric acid fused together, and afterwards ground to a fine powder.

It would appear, however, from the statements contained in a paper read by Mr Tatlock, F.R.S.E., F.C.S., that the enamel used for iron vessels is frequently of a less harmless kind than that described by Wagner. Mr Tatlock states that in some instances the milk-white porcelainous enamel, with which cast-iron cooking vessels are now so commonly prepared, has a composition such as to render it highly objectionable, on account of the facility with which it is acted upon by acids, fruits, common salt, and other ordinary dietetic substances, by which means lead, and even arsenic, are dissolved out in large quantity during cooking processes.

Mr. Tatlock gives the analysis of three samples of enamel from the interior of three cast-iron pots obtained from different manufacturers. These iron vessels were all employed for cooking:

	No. 1. per cent.	No. 2. per cent.	No. 3. per cent.
Silica	61·00	42·40	42·00
Alumina	8·00	2·88	6·06
Oxide of iron	1·10	2·04	4·04
Lime	3·02	0·16	0·78
Magnesia	0·28	0·10	0·21
Oxide of lead	absent	25·89	18·48
Potash	5·61	7·99	6·46
Soda	20·67	14·67	19·25
Phosphoric acid	trace	trace	trace
Arsenious acid	0·02	0·42	1·02
Carbonic acid	0·30	absent	absent
Borax	absent	3·45	1·70
	100·00	100·00	100·00
Total bases	38·58	53·73	55·28

The author showed that it was not so much on account of the presence of large proportions of lead and arsenic that the enamels are so dangerous, but because they are so highly basic in character that they are acted upon with facility by feebly acid solutions, the lead and arsenic being thereby easily dissolved out.

He demonstrated that the ratio of the bases to the silica in No. 1 was 1 to 1·58; in the No. 2, as 1 to 0·79; and in the No. 3, as 1 to 0·76. A 1% solution of citric acid boiled in the No. 1 did not affect it in the slightest, while in the case of the No. 3 the glassy surface of the enamel was at once roughened and destroyed, and lead dissolved out to such an extent as to give immediately a dense black precipitate with sulphuretted hydrogen. He thought that no enamel was fit to be used unless it was totally unaffected by boiling with a 1% solution of citric acid, which was a very moderate test; and gave it as his opinion that either the use of such poisonous ingredients as lead and arsenic in large quantity should be entirely abandoned, or that, otherwise, the composition of the enamel should

be of such a character as to ensure that none of the poisonous substances could be dissolved out, in the circumstances under which the enamelled vessels are used.

ENCAU'STIC. See PAINTING (Encaustic).

ENDEMIC. Indigenous. Peculiar to a district. Those are called endemic diseases which are produced by causes more or less local. The word is often confounded with epidemic.

ENE'MA. *Syn.* CLYSTER; EN'EMA (*pl.* ENE-M'ATA), L. A medicine, usually liquid (sometimes gaseous), thrown into the rectum or lower bowels.

Clysters usually consist of some weak glutinous or mucilaginous fluid, to which the active ingredients are added; or a decoction or infusion is made of the medicaments, which is then used, either alone, or after the addition of a little gum, starch, or sugar. The proper vehicle for astringent vegetable matter, metallic salts, and the mineral acids is pure water. Oleaginous and resinous substances are made into emulsions before being employed for enemas. The quantity of fluid forming a clyster, for an adult, may vary from ½ to ¾ pint; that for an infant within a month old should be about 1 fl. oz.; for a child of 1 year, about 2½ fl. oz.; from 1 to 7 years, 3 or 4 fl. oz.; and from 7 to 12 or 14, 6 or 7 fl. oz.; after that age to puberty, ½ pint may be employed.

The quantity or dose of the active ingredients in a clyster should be 4 or 5 times as great as that of the same medicines when taken by the mouth, as it is generally regarded that the susceptibility of the rectum is only 1-5th that of the stomach, and that to exert a like absorbent action it occupies 5 times as long as the latter viscus. The dose, and the interval between its repetition, should therefore be proportionately increased. Narcotics, as opium, tobacco, &c., should, however, be given in only twice or thrice the quantity that would be exhibited in the usual manner.

Enemata are usually administered by means of a syringe, bladder, or elastic bag, furnished with a rectum tube; but many ingenious and elegant pieces of mechanism, adapted for self-administration, are made by the instrument makers. Great care should be taken to avoid injuring the coats of the rectum by the use of a rough or improperly shaped pipe, or one that is too long, also to empty the instrument of air. The extremity of the pipe or tube should also be perfectly smooth and well rounded (rather spherical than pointed), and in using it no force should be employed. A neglect of this point often produces very serious consequences, especially in young children.

Tobacco smoke may be administered by means of a double pair of bellows, supplied with air from a small funnel under which the herb is burning; and gaseous matter, by connecting the rectum tube with a small gasometer, exerting a trifling pressure on the confined gas.

The number of substances employed in the preparation of enemata is very great. The following are some of them, arranged according to their effects.

1. (Anodyne and Narcotic.) Opium, henbane, &c., are employed to allay spasms of the bowels, stomach, uterus, bladder, &c.

2. (Aperient or Cathartic.) Aloes, colocynth, senna, various purging salts, gruel, decoction of marsh-mallows, decoction of linseed, warm water, &c., are commonly employed to promote the peristaltic action of the bowels or to destroy worms.

3. (Demulcent and Emollient.) Decoction of starch, gum, isinglass, glue, &c., either alone or combined with opium, are used to protect the coats of the intestines, and to allay irritation; and also to restrain diarrhœa, especially when combined with astringents, as logwood, catechu, or oak-bark.

4. (Nutrient.) Animal jelly, soups, broths, milks, &c., are frequently used as injections to convey nourishment to the body.

5. (Sedative.) Tobacco infusion or smoke, and tartar emetic (in solution), are employed to relax the powers of the body, to remove spasms, depress the circulation, and to produce syncope.

Enemata or clysters are now very frequently employed in our large towns, especially among the higher classes; but a great prejudice exists among many persons against their use, arising from a fastidious and mistaken delicacy. The introduction of improved apparatus of late years, by which the administration of these remedies is attended with less difficulty and exposure than formerly, has removed much of the repugnance which previously existed.

Clysters are invaluable when it is necessary to evacuate the bowels as speedily as possible, and when the stomach will not bear the administration of a purgative by the mouth, as well as in cases requiring a direct medication of the lower bowels, as in dysentery, colic, &c. As a mere laxative, an injection of tepid water, milk-and-water, or water gruel, will generally be found sufficient. By the addition of 1 or 2 tablespoonfuls of common salt, Epsom salts, salad oil, or molasses, to this laxative enema, it will form an excellent purgative one, which will, in most cases, induce a full discharge. In all cases the patient should be directed to retain the injection for as long a time as possible, and not to attempt to empty his bowels immediately after the reception of the medicine. "In irritation of the bladder, rectum, or uterus, an anodyne injection or enema often affords much relief. In diseases of the lower bowels, clysters are also of almost indispensable utility, as also in the dislodgment of ascarides seated in the rectum; nor are they less beneficial in those cases of sudden sinking of the powers of life where deglutition is impossible, and yet a prompt stimulating impression is requisite to save the patient; under such circumstances, clysters of some of the diffusible stimuli have proved of the greatest benefit."

The injection of large quantities of liquid matter into the bowels, as well as the constant use of clysters (even of warm water only), is deemed by the highest medical authorities to be injurious, and occasionally dangerous. The practice should not, therefore, be allowed to grow into a habit. The bowels continually accustomed to a stimulant cease to act without one. The same remarks apply to aperients taken by the mouth.

The following formulæ embrace the whole of

the enemas (ENEMATA) of the 'British Pharmacopœia,' as well as a few others in common use:

Enema of Albu'men. *Syn.* ENEMA ALBUMINIS, L. *Prep.* (*Ricord.*) Infusion of linseed, 12 oz.; whites of 2 or 3 eggs; mix. In chronic diarrhœa, and as a nutrient clyster in debility from stomach diseases. The reason for rejecting the yelks of the eggs is not very obvious, as the preparation is much more effective with them.

Enema of Al'oes. *Syn.* ENEMA ALOËS (B. P.), L. *Prep.* From aloes, 2 scr.; carbonate of potassa, 15 gr.; mucilage of starch, ½ pint. In ascarides, atonic amenorrhœa, &c. It should not be employed when irritability of the rectum, bladder, or genitals exists; nor in piles, or when there is a tendency to prolapsus ani or prolapsus uteri.

Enema, An'odyne. See ENEMA OF OPIUM.

Enema, Antispasmod'ic. *Syn.* ENEMA ANTISPASMODICUM, L. *Prep.* From tincture of assafœtida, 3 fl. dr.; laudanum, 30 to 60 drops; water gruel or barley water, ½ pint. In spasmodic affections of the bowels (see *below*).

Enema of Assafœt'ida. *Syn.* FŒTID CLYSTER, ANTISPASMODIC C.; ENEMA ASSAFŒTIDA (B. P.), E. FŒTIDUM (Ph. E. & D.), L. *Prep.* 1. (B. P.) Assafœtida, 30 gr.; water, 4 oz.; rub together until mixed.

2. (Ph. E.) To cathartic enema (Ph. E.), add of tincture of assafœtida, 2 fl. dr.

3. (Ph. D.) Warm water, 12 fl. oz.; tincture of assafœtida, 2 fl. dr.

4. (St B. Hosp.) Assafœtida, 2 dr.; yelk of an egg; barley water, 7 fl. oz. Stimulant, antispasmodic, and carminative. An excellent remedy in hysteria, flatulent colic, hooping-cough, infantile convulsions, worms in the lower bowels, &c. See ENEMA, HOOPING-COUGH.

Enema, Astrin''gent. *Syn.* ENEMA ASTRINGENS, L. *Prep.* 1. Tincture of catechu, 1 fl. oz.; barley water, 9 fl. oz.

2. Extract of rhatany, 2 dr.; syrup or made starch, 2 oz.; water, 7 fl. oz.

3. Decoction of galls, oak-bark, pomegranate, or other like astringent substance, 3 or 4 fl. oz.; water or barley water, 6 or 7 fl. oz.

4. (Hosp. F.) Electuary of catechu, 2 dr.; water and lime water, of each, 4½ fl. oz. In diarrhœa, &c., arising from a relaxed condition of the coats of the lower bowels; and in fissures of the anus, &c.

Enema of Bark. *Syn.* ENEMA CINCHONÆ. Decoction of bark is used.

Enema of Belladonna. *Syn.* ENEMA BELLADONNÆ. (*Ratier.*) *Prep.* Belladonna, 10 gr.; water, 6 oz.; infuse.

Enema of Cam'phor. *Syn.* ENEMA CAMPHORÆ, L. *Prep.* 1. Camphor liniment, 4 fl. dr.; yelks of 2 eggs; water gruel, 7 fl. oz.

2. Camphor, 1 dr.; rectified spirit, 2 dr.; triturate till dissolved, then add, gradually, of simple syrup, 1 oz.; when thoroughly incorporated, further add of thin gruel, 7 fl. oz. Anodyne, antispasmodic, and diuretic. In difficult or obstructed micturition.

Enema of Cas'tor Oil. *Syn.* ENEMA OLEI RICINI, L. *Prep.* 1. (Hosp. F.) Castor oil and mucilage, of each, 1 oz.; gruel, ½ pint.

2. Castor oil, 1 oz.; liquor potassa, 2 fl. dr.; triturate, and add of honey, 1 oz.; when mixed, further add of hot gruel, ½ pint; and agitate until cool enough to be administered.

Enema, Cathar'tic. *Syn.* PURGATIVE CLYSTER; ENEMA CATHARTICUM (B. P., Ph. E. & D.), E. LAXATIVUM, E. PURGATIVUM, L. These have been already alluded to. By increasing the quantity of the active ingredients, a mild laxative or aperient clyster is converted into an active purgative or cathartic one.

Prep. 1. (Ph. E.) Senna, ½ oz.; boiling water, 16 fl. oz.; infuse an hour, then add of Epsom salts, ½ oz.; sugar, 1 oz.; when dissolved, further add of olive oil, 1 oz.; and mix them by agitation.

2. (Ph. D.) Epsom salts, 1 oz.; olive oil, 1 fl.oz.; mucilage of barley, 16 fl. oz. Same as enema of sulphate of magnesia (B. P.), except that in the latter mucilage of starch is substituted for mucilage of barley.

3. (Ph. D. 1826.) Manna, 1 oz.; compound decoction of chamomile, ½ pint; dissolve and add of olive oil, 1 oz.; Epsom salts, ½ oz.

4. Compound decoction of mallows, ½ pint; Epsom salts, ⅝ oz.; sweet oil, 2 fl. oz.; mix, as above.

Obs. The above are employed in all ordinary cases where the use of an immediate cathartic is indicated.

Enema of Chloride of Soda. *Syn.* ENEMA SODÆ CHLORINATÆ. *Prep.* Labarraque's solution, 24 drops; decoction of mallows, 16 oz.

Enema of Chloride of Sodium. *Syn.* ENEMA SODII CHLORIDI. *Prep.* Common salt, 1 oz.; barley water, ½ pint; olive oil, 1 oz.

Enema for Col'ic. *Syn.* ENEMA ANTICOLICUM, L. *Prep.* From oil of cajeput or peppermint, 15 drops; dissolved in sweet spirit of nitre, 60 drops; laudanum, 35 drops; infusion of chamomile, ½ pint.

Enema of Col'ocynth. *Syn.* ENEMA COLOCYNTHIDIS (Ph. L.), L. *Prep.* 1. (Ph. L.) Extract of colocynth, ½ dr.; soft soap, 1 oz.; triturate, and add of water, 1 pint.

2. (Ph. L. 1836.) As the last, but using compound extract of colocynth.

3. (Guy's Hosp.) Colocynth pulp, 1 dr.; water, ¾ pint; boil so as to strain ½ pint; and add of common salt, ½ oz.; syrup of buckthorn, 1 fl. oz. An efficient enema in colic and obstinate constipation in the absence of spasms and inflammatory symptoms.

Enema, Com'mon. *Syn.* ENEMA COMMUNE, L. Gruel and barley water, either with or without the addition of a little common salt or oil, are generally so called. The first are simply laxative; the latter purgative. Decoction of mallows, linseed tea, or water gruel is also commonly used as the vehicle.

Prep. 1. (St B. Hosp.) Barley water, 1 pint; common salt, 1 oz.; dissolve.

2. (Guy's Hosp.) Water gruel, 10 to 15 fl. oz.; common salt, 1 oz.

3. (U. C. Hosp.) Water gruel, 8 to 12 fl. oz.; salt, 1 oz.; linseed oil, 2 fl. oz.

Enema of Copai'ba. *Syn.* ENEMA COPAIBÆ, L. *Prep.* 1. From balsam of copaiba, 2 dr.; liquor opii sedativus, 15 drops; yelk of egg, q. s.; barley water, 7½ fl. oz.

2. (*Collier.*) To the last add, of extract of opium, 1 gr.; oil of turpentine, 4 fl. dr.

3. (*Velpeau.*) Copaiba, 2 dr.; laudanum, 20 drops; yelk of 1 egg; water gruel, 8 fl. oz. In ascarides, gonorrhœa, and some affections of the lower bowels and bladder when the stomach rejects the balsam.

Enema of Creosote. *Syn.* ENEMA CREOSOTI. (*Dr Wilmot.*) Creosote, 1 dr.; decoction of starch, 12 oz. In epidemic dysentery.

Enema of Croton Oil. *Syn.* ENEMA OLEI CROTONIS. (*Sundelin.*) *Prep.* Croton oil, 2 to 4 drops; linseed oil, 2 oz.; gruel, 4 oz.

Enema of Cubebs. *Syn.* ENEMA CUBEBÆ. (*Velpeau.*) *Prep.* Decoction of mallow, 10 oz.; powdered cubebs, 6 dr.

Enema, Domes'tic. *Syn.* ENEMA DOMESTICUM, L. This name has been applied to an enema of warm water, either with or without the addition of a little sugar, honey, or milk. The effect is laxative.

Enema, Emoll'ient. *Syn.* ENEMA EMOLLIENS, E. DEMULCENS, L. *Prep.* From decoction of linseed, barley, or starch, 1 pint; linseed or olive oil, 1 oz. Soothing and laxative; in excoriations of the lower bowels. 20 to 40 drops of laudanum may be added when there is much pain or looseness.

Enema of Ergot. *Syn.* ENEMA ERGOTÆ. (*Boudin.*) *Prep.* Infuse 1 dr. of ergot in 8 oz. of hot water and strain.

Enema, Feb'rifuge. *Syn.* ENEMA FEBRIFUGUM, L. *Prep.* 1. (*Collier.*) Water gruel, 12 fl. oz.; sugar, 1 oz. In low fevers.

2. (*Brande.*) Vinegar, 2 fl. oz.; infusion of chamomile, 5 or 6 fl. oz. In typhus.

Enema, Fœ'tid. See ENEMA OF ASSAFŒTIDA.

Enema of Galls and Opium. *Syn.* ENEMA GALLÆ ET OPII. (*Dr Ryan.*) *Prep.* Decoction of galls, 8 oz.; tincture of opium, ½ dr.

Enema for Hoop'ing-cough. *Syn.* ENEMA PERTUSSICULARE, L. *Prep.* 1. See ENEMA OF ASSAFŒTIDA.

2. (*M. Reiken.*) Assafœtida, 8 gr.; yelk of 1 egg; water, ½ pint.

Obs. This quantity is sufficient for 10 or 12 clysters for children under 1 year; 5 or 6 for those under 3 years; and 2 or 3 for those under 7. Two clysters are prescribed daily in hooping-cough. According to M. Reiken, this is more successful in removing hooping-cough than any other remedy. To ensure success, it should not be administered until the feverish symptoms have passed. M. Reiken sometimes uses an ointment of assafœtida as well as the clyster.

Enema of Ipecacuanha. *Syn.* ENEMA IPECACUANHÆ. (U. C. Hosp.) Ipecacuanha root (bruised), 1 dr.; boiling water, 8 oz. Macerate for an hour and strain.

Enema, Lax'ative. See ENEMAS (Cathartic, Common, &c.).

Enema, Nu'trient. *Syn.* FEEDING CLYSTER; ENEMA NUTRIENS, L. *Prep.* 1. Strong beef tea, 12 fl. oz.; thickened a little with arrowroot or hartshorn shavings.

2. (*M. Nasse.*) Strong meat soup, ¾ pint; dilute hydrochloric acid, ½ fl. dr.

3. Yelks of 2 eggs; brown sugar and salad oil, of each, 1 oz.; mutton broth, 12 fl. oz. To nourish the body when aliments cannot be taken or retained by the stomach.

Enema, Oi''ly. See ENEMA (Emollient).

Enema of O'pium. *Syn.* ENEMA OPIATUM, E. OPII (B. P. and Ph. L.), E. OPII vel ANODYNUM (Ph. E.), L. *Prep.* 1. (B. P.) Mucilage of starch, 2 fl. oz.; tincture of opium, ½ dr.

2. (Ph. E.) Starch, ½ dr.; water (boiling), 2 fl. oz.; mix, and when cool enough add of tincture of opium, ½ to 1 fl. dr.

3. (Ph. D. 1826.) Laudanum, 1 dr.; warm water, 6 fl. oz.

Obs. The above are the orders of the colleges, but in practice the quantity of laudanum is frequently doubled; this should, however, be done with great care. Opium clysters are used in dysentery, colic, cholera, and various painful affections of the intestines, bladder, &c. The bowels should be emptied before their administration, and in inflammatory complaints they should not be used for the first 48 hours. Clysters containing opium, even in small quantities, are dangerous remedies for young children; yet there are cases in which they sometimes succeed when every other remedy has failed. This is particularly so in the low chronic diarrhœa of infancy and early childhood. A case of this kind occurred in the family of the writer, the little sufferer being apparently beyond the reach of further assistance. A small opium clyster was given, and the child recovered.

Enema of Ox-gall. *Syn.* ENEMA FELLIS, E. F. BOVIS, L. *Prep.* (*Dr Allnatt.*) Fresh ox-gall, 2 fl. oz.; water gruel, 8 fl. oz.

2. (*Dr Clay.*) Ox-gall, 2 fl. oz.; water, 4 or 5 fl. oz. To soften indurated fæces, and in costiveness arising from deficiency of bile.

Enema of Pop'pies. *Syn.* ENEMA PAPAVERIS, L. *Prep.* 1. DECOCTION OF POPPIES.

2. Poppy-heads (with the seeds), 5 dr.; water, ¾ pint; boil to 12 fl. oz. and strain. Anodyne; as a substitute for opium clyster.

Enema, Pur'gative. See ENEMA, CATHARTIC.

Enema of Quinine. *Syn.* ENEMA QUINIÆ. Sulphate of quinine, 5 to 15 gr.; decoction of starch, 6 oz.

Enema of Rue. *Syn.* ENEMA RUTÆ. *Prep.* Confection of rue, 20 to 60 gr.; thin gruel, 6 oz. to 8 oz.

Enema, Sim'ple. Barley water, rice water, thin-made starch, and decoction of mallows are frequently so called, from being used either for simple laxative enemas, or as the vehicle for more active substances.

Enema of Soap. *Syn.* ENEMA SAPONIS, L. *Prep.* (St B. Hosp.) Soft soap, 6 dr.; hot water, 1 pint; dissolve. To soften indurated fæces, &c.; and as a detergent in certain ulcerations of the rectum.

Enema of Starch. *Syn.* ENEMA AMYLI, L. See ENEMA, SIMPLE (*above*).

Enema, Stim'ulant. *Syn.* ENEMA STIMULANS, L. The ordinary cathartic clysters are often so called. The following belong to a different class:

Prep. 1. Tincture of capsicum, 1 fl. oz.; barley water or thin arrowroot, ½ pint; mix. In cholera, especially the cold stages.

2. To the last add, of ether, 4 fl. dr.; laudanum, 30 drops.

3. Decoction of poppies, ½ pint; tincture of capsicum, 3 fl. dr.; oil of nutmeg, 10 drops. In diarrhœa.

Enema of Tobac'co. *Syn.* ENEMA TABACI (Ph. L. E. and D.), INFUSUM TABACI (Ph. D. 1826), L. *Prep.* 1. (B. P.) Tobacco leaf, 20 gr.; boiling water, 8 oz.; infuse ½ hour and strain.

2. (Ph. E.) Tobacco, 15 to 30 gr.; boiling water, 8 fl. oz.; as last.

3. (Ph. D.) Tobacco, 1 scr.; boiling water, 8 fl. oz.

4. (Ph. L. 1836.) Tobacco, 1 dr.; boiling water, 1 pint.

Obs. Tobacco clyster is used in strangulated hernia, obstinate constipation, retention of urine, &c. It is violently depressing and relaxing; producing fainting, and even death, when improperly or injudiciously administered. "It is not to be forgotten that 2 dr., 1 dr., and even ½ dr. of tobacco, infused in water, have proved fatal." "The cautious practitioner, therefore, will not use more than 15 or 20 gr." (*Pereira*). Three parts of Virginia tobacco are equal to 7 parts of any other kind (*Davy*).

Enema of Tur'pentine. *Syn.* TURPENTINE CLYSTER; ENEMA TEREBINTHINÆ (Ph. L.), E. OLEI T., L. *Prep.* 1. (B. P.) Oil of turpentine, 1 oz.; mucilage of starch, 15 oz.

2. (Ph. L.) Oil of turpentine, 1 fl. oz.; yelk of 1 egg; triturate together, then add of decoction of barley, 19 fl. oz.

3. (Ph. E.) As the last, but using simple water instead of barley water.

4. (Ph. D.) Oil of turpentine, 1 fl. oz.; mucilage of barley, 16 fl. oz.

5. (*Dr Neligan.*) Oil of turpentine, ½ fl. oz.; syrup of garlic, 1 fl. oz.; barley water, 6 or 7 fl. oz. In ascarides, and as an antispasmodic and purgative in colic, obstinate constipation, calculus, peritonitis, tympanites (DRUM-BELLY), &c.

Enema, Ver'mifuge. *Syn.* ENEMA ANTHELMINTICUM, E. VERMIFUGUM, L. *Prep.* 1. Castor oil, 1 oz.; mucilage, ¾ oz.; decoction of the root of male fern, 7 fl. oz. In worms, especially tapeworm.

2. (*Collier.*) Oil of turpentine, 1 fl. oz.; olive oil (warm), ½ pint. In ascarides.

3. (*Dr Darwall.*) Tincture of sesquichloride of iron, 1 dr.; water, 7 or 8 fl. oz. In ascarides, especially when occurring in childhood, the quantity used being proportionately lessened. See ENEMAS OF ALOES, ASSAFŒTIDA, TURPENTINE, &c.

Enema of Vinegar. *Syn.* ENEMA ACETICI. (*Brande.*) *Prep.* Vinegar, 2 oz.; infusion of chamomile, 4 oz. In typhus fever.

Enema of Wine. *Syn.* ENEMA VINOSUM, L. *Prep.* From sherry wine and hot water, of each, 7 fl. oz. In suspended animation. Sometimes a wine-glassful of brandy is added.

ENERGY, RELATIVE VALUES OF FOOD AS SOURCES OF. Chemists and physiologists, although they agree that muscular power is derived from the action of the oxygen supplied during respiration upon the digested portions of the food, differ in their conclusions as to whether the nitrogenous or non-nitrogenous principles of the food form the chief source of this power or not. The opinion of Liebig, Playfair, Ranke, and others, that the oxidation and metamorphosis of the nitrogenous tissue is the fountain of muscular force has of late years been contested, and the opposite view adduced, viz. that it is principally from the oxidation of the carbonaceous or non-nitrogenous constituents of the food that the energy of the animal body is derived.

This latter view has received support from the experiments of Frankland, Lawes, and Gilbert (from their observations on the feeding of cattle), Edward Smith, Meyer, Pettenkofer, Voit, Wislicenus, Fick, Parkes, and others.

The data upon which it is based are those derived from the observation of the amount of heat generated by the combustion of a definite quantity of food out of the body, which it is affirmed, with certain deductions, represents the quantity of heat evolved by the oxidation of the same food within the body; and as heat is the equivalent of muscular force or energy, that aliment which, in burning, gives off the most heat, must, it is supposed, necessarily be the richest in the production of animal motive power. Of course these conditions will, amongst others, be very considerably modified by the extent to which the processes of the animal economy, such as digestion, assimilation, &c., can liberate the elements of the food so as to become available as sources of this energy.

Were these processes perfect, all the carbon of the carbonaceous, as well as that of the nitrogenous constituents of the diet, after deducting the carbon which passes off as urea (1 part of dry nitrogenous matter yielding about a third of its weight of urea) would be utilised and converted into heat-producing power. But even under these circumstances a considerable portion of this power would be expended in sustaining the internal movements of the body, such as respiration and the heart's action, which it has been computed are daily maintained by a force capable of raising 600,000 lbs. a foot high.

No wonder if, with such varying factors introduced into the problem, physiologists and physicists should differ so widely in their calculations; and that, whilst one inquirer believes that food practically yields only about half the force which, according to theory, it actually contains, another estimates it at only 1-5th.

The following table by Frankland shows the amount of force which different foods yield when burned. The results agree very closely with those theoretically given by Playfair and others.

The amount of work done is generally estimated in this country as so many lbs. or tons lifted 1 foot. In France it is expressed as so many kilogrammes lifted 1 metre, and called 'the kilogramme-metre,' as above.

"A table of this kind," says Dr Parkes, "is useful in showing what can be obtained from our food, but it must not be supposed that the value of food is in exact relation to the energy which it can furnish. In order that the force shall be obtained, the food must not only be digested and taken into the body properly prepared, but its energy must be developed in the place and in

Energy developed by 1 *grm. or* 1 *oz. of the following substances, when oxidised in the body.*

Name of Substance.	Per cent. of Water.	1 gramme will equal kilo-metres of Energy.	1 ounce will equal foot-tons of Energy, or in other words, would raise the under-given number of tons 1 foot high.
Beef (lean) . . .	70·5	604	55·0
Veal (lean) . . .	70·9	496	45·3
Ham (lean, boiled) .	54·4	711	64·9
Bread-crumb . . .	44·0	910	83·0
Flour	...	1627	148·5
Ground rice . . .	...	1591	145·3
Oatmeal	...	1665	152·0
Pea meal	...	1598	146·0
Potatoes	73·0	422	38·5
Carrots	86·0	220	20·0
Cabbage	88·5	178	16·2
Butter	...	3077	280·9
Egg (white of) . .	86·3	244	22·3
Egg (yelk)	47·0	1400	127·0
Cheshire cheese . .	24·0	1846	168·5
Arrowroot	...	1656	151·3
Milk	87·0	266	24·3
Sugar (lump) . . .	...	1418	129·5
Ale (Bass's bottled) .	88·4	328	30·0
Porter (Guinness's stout)	88·4	455	41·5

the manner proper for nutrition. The mere expression of potential energy cannot fix dietetic value, which may be dependent on conditions in the body unknown to us. For example, it is quite certain, from observation, that gelatin cannot take the place of albumen, though its potential energy is little inferior, and it is easily oxidised in the body. But owing to some circumstances yet unknown, gelatin is chiefly destroyed in the blood and gland-cells, and its energy, therefore, has a different direction from that of albumen. So also of the potential energy, it is quite possible that all is not usefully employed. The tables of energy give broad indications, and can be used in a general statement of the value of a diet; but at present they do not throw light upon the intricacies of nutrition."

ENFLURAGE. See Pommade.

ENGRA′VING. The art of producing designs or figures on metal, wood, &c., by incision or corrosion, usually for the purpose of being subsequently printed on paper, calico, or other materials. The mechanical operations of the engraver do not come within the province of this work. Several of the materials which he employs in his trade will, however, be found noticed under their respective heads.

There is this important difference between engraving on metal plates and wood-engraving: in the former all the lines and dots that are to print black are hollowed out with a graving-tool, or 'bitten in' by acid; in the latter all the parts that are to appear white in the impression are cut away, and the lines which produce the imprint are left on the face of the block.

Casts of wood-blocks, or 'stereos,' are often used instead of the original blocks when a great number of impressions are required. To produce them stucco moulds are prepared, and from these the casts in type metal are taken. The casts are usually 1-8th inch thick, and have to be screwed upon wooden blocks to bring them to the height of the types which are printed with them. As soon as one cast is worn out another may be taken, and the original block is thus preserved in the state in which it left the engraver's hands.

For the reproduction of engraved metallic plates the electrotype process is commonly employed. Woodcuts are also copied, though less frequently, by this process. The mode by which the postage-stamp plates are multiplied is as follows:—240 'queen's heads' or stamps (a pound's worth) are engraved on one steel plate. This plate is then hardened, and an impression of it taken on a softened steel roller. This roller, in its turn, is also hardened, and softened steel plates being passed under it, an impression precisely like that of the original plate is produced on each of them. These plates are then hardened and employed for printing the penny postage stamps for sale. They last a long time; and when they are worn out they are destroyed, and their place is supplied by fresh ones, which are produced by the cylinder before referred to, which continues ready to supply any number that may be required. Bank-note plates are reproduced in a similar manner. See Electrotype, Etching, Photography, &c.

Engravings, to Clean. This is a task which should never be attempted without careful consideration. Rubbing with bread will remove mere dust, but great care is required, or the friction will remove the ink and destroy the fine lines of the engraving. A very dilute solution of chloride of lime (1 part in 39 of water) will remove most brown stains. The engraving should be floated on the solution for a time, and then floated on several lots of clean water; then lay the print on *clean* blotting-paper to dry; avoid touching the surface with the fingers as much as possible. Grease-spots may be removed by the *careful use* of benzine, which should first be applied all round the stain, then to the stain itself. It is a good plan to iron a print, after wetting and drying; sheets of perfectly smooth clean paper should be placed on the print, and over these a sheet of thick brown paper. Valuable prints should be sent to an expert for cleaning, as the successful carrying out of these processes requires skill and practice. An inexperienced hand may, with the best intentions, utterly ruin an engraving.

Engravings, to Mount. Strain thin calico on a frame, then carefully paste on it the engraving, so as to be free from creases; afterwards, and when dry, give the engraving 2 coats of thin size (made by putting a piece of glue the size of a small nut into a small cupful of hot water).

ENTERI′TIS. See Inflammation of the Bowels.

ENTOZO′A. Parasitic animals which infest the bodies of other animals. See Worms.

ENTRY, Powers of. The Public Health Act thus defines the power of any local authority to enter into premises whereon a nuisance is sup-

posed to exist, and the conditions under which this power is to be exercised.

Entry, Powers of, under the Public Health Act, 1875, are given for the following purposes:

1. *On land for the construction of sewers* (section 16).

2. *For the inspection of existing drains, sewers, privies, water-closets, and ashpits* (section 41).

3. *Under justice's order to cleanse boundary ditches* (section 48).

4. *For the abatement of nuisances* (section 102).

"The local authority or any of their officers shall be admitted to any premises for the purpose of examining as to the existence of any nuisance thereon, or of enforcing the provisions of any Act in force within the district requiring fireplaces and furnaces to consume their own smoke at any time between the hours of *nine* in the forenoon and *six* in the afternoon, or in the case of a nuisance arising in respect of any business, then at any hour when such business is in progress or is usually carried on.

"Where under this Act a nuisance has been ascertained to exist, or an order of abatement or of prohibition has been made, the local authority or any of their officers shall be admitted from time to time into the premises between the hours aforesaid until the nuisance is abated or the works ordered to be done are completed, as the case may be.

"Where an order of abatement or prohibition has not been complied with or has been infringed, the local authority or any of their officers shall be admitted from time to time at all reasonable hours or at all hours during which business is in progress or is usually carried on, into the premises where the nuisance exists, in order to abate the same.

"If admission to premises for any of the purposes of this section is refused, any justice on complaint thereof *on oath* by any officer of the local authority (made after reasonable notice in writing of the intention to make the same has been given to the person having custody of the premises) may, by order under his hand, require the person having custody of the premises to admit the local authority or their officer into the premises during the hours aforesaid; and if no person having custody of the premises can be found, the justice shall, *on oath* made before him of that fact, by order under his hand, authorise the local authority or their officer to enter such premises during the hours aforesaid.

"Any order made by a justice for admission of the local authority or their officer on premises shall continue in force until the nuisance has been abated, or the work for which the entry was necessary has been done.

"Any person refusing to obey an order of a justice for admission of the local authority or any of their officers is liable to a penalty not exceeding £5."

5. *For the inspection of food.*

Power is given by section 116 to the medical officer of health or inspector of nuisances to enter premises for the inspection and examination of food at all reasonable times. By the same section powers are given to seize and deal with unwholesome food.

6. *To enforce regulations made during the prevalence of epidemic disease* (section 137).

7. *To the rural sanitary authority to ascertain sufficiency of water-supply* (by section 7, Public Health (Water) Act, 1878).

8. *For the inspection of bakehouses.*

9. Powers of entry are also given *for the inspection of dairies and cowsheds* under the Dairies, Cowsheds, and Milkshops Order of 1885. See INFECTIOUS DISEASES.

ENURE'SIS. See URINE.

EPHESTIA ELETELLA—the Chocolate Moth. The larvæ of this moth frequently cause serious damage to cocoa, flour, or biscuits when these are stored. Professor Huxley proposes to guard against the ravages of the insect by the adoption of the following precautions:

1. Have no cocoa stored in any place in which biscuits are manufactured.

2. Lead up all biscuit puncheons as soon as they are full of the freshly-baked biscuit.

3. Coat puncheons with tar after they are leaded up, or at least work lime-wash well into the joints and crevices.

4. Line the bread-rooms of the ships with tin, so that if the Ephestia has got into a puncheon it may not infest the rest of the ship.

5. If other means fail, expose the woodwork of puncheons to a heat of 200° F. for 2 hours; or they might be destroyed by driving into the puncheon a stream of carbonic oxide, and afterwards exposing it well to the air. Weevils in biscuit have frequently been exterminated by this method, and there appears to be no reason why this treatment should not be equally efficacious for getting rid of the larvæ of the *Ephestia eletella.*

EPHIAL'TES. See NIGHTMARE.

EPIDEM'IC. Common to many people. In *pathology*, an epidemic disease (EPIDEMIC; EPIDEMY) is one which seizes a number of people at the same time and in the same place, but which is not necessarily dependent on any local cause. When a disease is peculiar to a people or nation, and appears to depend on local causes, it is said to be 'ENDEMIC' or 'ENCHORIAL.' Thus, Asiatic cholera may be taken as an example of the first, and the agues of low countries, and the goitre of the Alps as examples of the other.

Epidemics may be divided into indigenous and exotic. Amongst the former may be included scarlet fever, measles, hooping-cough, influenza, typhoid; whilst the latter embrace such as are imported, viz. Asiatic cholera, plague, &c.

The following enactments for the prevention of epidemic diseases are now in force:

"Whenever any part of England appears to be threatened with, or is affected by, any formidable epidemic, endemic, or infectious disease, the Local Government Board may make, and from time to time alter and revoke, regulations for all or any of the following purposes, viz.:

"(1) For the speedy interment of the dead; and—

"(2) For house-to-house visitation; and—

"(3) For the provision of medical aid and accommodation, for the promotion of cleansing, ventilation, and disinfection, and for guarding against the spread of the disease; and may by

order declare all or any of the regulations so made to be in force within the whole or any part or parts of the district of any local authority, and to apply to any vessels as well as arms or parts of the sea within the jurisdiction of the Lord High Admiral of the United Kingdom, or the Commissioners for executing the office of the Lord High Admiral for the time being, for the period in such order mentioned; and may by any subsequent order abridge or extend such period" (P. H., s. 134).

"All such regulations, &c., made by the Local Government Board are to be published in the 'London Gazette,' and such publication shall be conclusive evidence thereof for all purposes" (P. H., s. 135).

"The local authority of any district within which, or part of which, regulations so issued by the Local Government Board are declared to be in force shall superintend and see to the execution thereof, and shall appoint and pay such medical or other officers or persons, and do and provide all such acts, matters, and things as may be necessary for mitigating any such disease, or for superintending or aiding in the execution of such regulations, or for executing the same, as the case may require. Moreover, the local authority may from time to time direct any prosecution or legal proceedings for or in respect of the wilful violation or neglect of any such regulation" (P. H., s. 136).

"The local authority and their officers shall have power of entry on any premises or vessel for the purpose of executing or superintending the execution of any regulations so issued by the Local Government Board as aforesaid" (P. H., s. 137).

"Whenever, in compliance with any regulation so issued by the Local Government Board as aforesaid, any poor-law medical officer performs any medical service on board any vessel, he shall be entitled to charge extra for such service at the general rate of his allowance for services for the union or place for which he is appointed, and such charges shall be payable by the captain of such vessel on behalf of the owners thereof, together with any reasonable expenses for the treatment of the sick.

"Where such services are rendered by any medical practitioner who is not a poor-law medical officer, he shall be entitled to charges for any service rendered on board, with extra remuneration on account of distance, at the same rate as those which he is in the habit of receiving from private patients of the class of those attended and treated on shipboard, to be paid as aforesaid. In case of dispute in respect of such charges, such dispute may, where the charges do not exceed *twenty pounds*, be determined by a court of summary jurisdiction; and such court shall determine summarily the amount which is reasonable, according to the accustomed rate of charge within the place where the dispute arises for attendance on patients of the like class as those in respect of which the charge is made" (P. H., s. 138).

"The Local Government Board may, if they think fit, by order authorise or require any two or more local authorities to act together for the purposes of the provisions of this Act relating to prevention of epidemic diseases, and may prescribe the mode of such joint action, and of defraying the costs thereof" (P. H., s. 139).

"Any person who—

"(1) Wilfully violates any regulation so issued by the Local Government Board, as aforesaid; or

"(2) Wilfully obstructs any person acting under the authority or in the execution of any such regulation, shall be liable to a penalty not exceeding five pounds" (P. H., s. 140).

EPIGAS'TRIC. In *anatomy*, pertaining to the EPIGAS'TRIUM, or the part of the abdomen over the stomach.

EPILEP'SY. *Syn.* FALLING SICKNESS; EPILEPSIA, MORBUS CADUCUS, L. The popular name of this disease arises from the patient, when attacked by it, suddenly falling to the ground. The other leading symptoms consist of convulsions, stupor, and, generally, frothing at the mouth. It comes on by fits, which after a time go off, leaving a certain amount of lassitude and drowsiness behind. Sometimes certain peculiar symptoms precede the attack. Among these, a sensation of coldness or of a current of cold air from the extremities of the body towards the head (AURA EPILEPTICA), palpitation, flatulency, stupor, and an indescribable cloud or depression are the most common. The occurrence of these symptoms are not, however, uniform, even in the same patient; but it generally happens that they fall down suddenly and without the slightest warning.

In such cases the treatment must be energetically directed to the removal of the exciting cause.

When epilepsy occurs as an idiopathic or primary affection, or when it cannot be referred to any apparent cause, more especially when the attack commences about the age of puberty, and the fits are frequent, there is great danger of the patient becoming maniacal or ultimately demented.

The treatment of idiopathic epilepsy is principally directed to the improvement of the general health, and the diminution of nervous irritability by sedatives and tonics. Bromide of potassium exerts a marked influence on the frequency and severity of the attacks.

During a fit of epilepsy the best thing that can be done for the patient is to prevent the sufferer injuring himself, and to loosen every part of his dress that presses on his head, neck, or chest.

Epilepsy more commonly attacks children than adults, and boys than girls. Its returns are frequently periodical, and its paroxysms commence more frequently in the night than in the day, being somewhat connected with sleep. It is sometimes counterfeited by street impostors in order to excite the charity of the passers-by.

For Animals. All animals are subject to attacks of epilepsy, more particularly dogs and pigs. The animal seized with the fit loses the senses of sight and hearing, and falling down exhibits the same symptoms as those which accompany the disease in human beings. Cattle, although they bellow greatly during an attack, rarely die from it; but it not infrequently suffocates dogs, and is in them a not unusual cause of sudden death. The fit, which lasts from 10 to 50 minutes, when it

passes off, leaves the animal dull, and is apt to return. Epileptic fits are a frequent accompaniment of distemper in dogs. They are often induced in cattle by tough and indigestible food, and, in these as well as in dogs, by intestinal worms. Hot weather and excitement, especially in dogs, are a frequent cause of an epileptic fit. By energetic treatment after the first attack the further course of the malady may often be arrested. The best treatment is to give, when the fit is over, a brisk purge, with an ounce of oil of turpentine in horses or cattle, and 20 to 40 drops in dogs. If the disease is caused by worms give the medicines ordered in such cases.

EPISPAS'TICS. See BLISTER and VESICANT.

EP'ITHEM. *Syn.* EPITHEMA, L. Any external liquid medicine for local application; as an embrocation or lotion. Some writers confine the term to those preparations which are intended to be applied by means of a cloth dipped into them. See LINIMENT, LOTION, &c.

Epithem, Astringent. *Syn.* EPITHEMA ASTRINGENS, L. *Prep.* 1. Powdered ice, 7 dr.; powdered catechu, 1 dr.; mix.

2. (*Brera.*) Powdered bole and rhatany, of each, 1 oz.; vinegar of roses, q. s. to form a paste. Both are applied to the nostrils and forehead to stop bleeding at the nose.

Epithem, Glyce″rin. *Syn.* EPITHEMA GLYCERINÆ, L. *Prep.* (*Mr Startin.*) Glycerin, 1 oz.; rose-water and lime-water, of each 3 or 4 fl. oz.; powdered gum tragacanth, q. s. to form a thin mucilage. In scalds, burns, and excoriations.

Epithem, Vermifuge. *Syn.* EPITHEMA VERMIFUGUM, L. *Prep.* (*Hoffmann.*) Wormwood and centaury, beaten up with aloes and colocynth, and applied over the belly.

Epithem, Vesica'ting. *Syn.* EPITHEMA VESICATORIUM, L. *Prep.* 1. (*Alibert.*) Rye or barley-meal, made into a paste with vinegar, and 30 to 40 gr. or more of powdered Spanish flies sprinkled over the surface.

2. (Ph. L. 1746.) Spanish flies (in fine powder), and wheat-flour, equal parts, made into paste with vinegar, q. s. As a blister.

Epithem, Volatile. *Syn.* EPITHEMA VOLATILE, E. AMMONIÆ, L. *Prep.* (Ph. L. 1764.) Common turpentine and water of ammonia, equal parts. An excellent counter-irritant; either with or without the addition of a little olive oil.

EPIZOÖTIC DISEASES. These are diseases which attack different species of domestic animals in the same manner that epidemics do man. These maladies ravage large tracts of country, frequently causing great mortality amongst the various animals inhabiting the localities visited by them; different animals being assailed by different forms of epizoötic disease.

For instance, there is the rinderpest, or plague peculiar to cattle; the foot-and-mouth disease, which prevailed so largely amongst horses in this country in 1854, and 1861 and 1862; the small-pox of sheep; the diphtheria affecting oxen, sheep, goats, and pigs; the influenza of horses, and the charbon of pigs. Dogs, cats, tame and wild birds, fish, silk-worms, and bees, each suffer from a special variety of epizoötic disease.

Epizoötic diseases are met with in most European countries. They are very common in Russia, where they commit great devastation amongst the horned cattle, 400,000 of which are said to die annually from their ravages. See AMERICAN HORSE DISEASE, INFLUENZA, MENINGITIS, PLEURISY.

EQUISE'TIC ACID. In *chemistry*, a substance identical with ACONITIC ACID (which *see*).

EQUIVA'LENT. (EQUIVALENCY.) In modern *chemistry*, the equivalent of a body is that weight of it which will exactly replace in a compound 1 atom of hydrogen, or 1 atom of either of the monovalent elements (see Table *below*).

Monovalent elements are those which replace 1 atom of hydrogen in chemical combinations in the ratios of their atomic weights.

One atom of a divalent, trivalent, tetravalent, pentavalent, and hexavalent element replaces, respectively, or is equivalent to, 2, 3, 4, 5, or 6 atoms of hydrogen or of any other monovalent element.

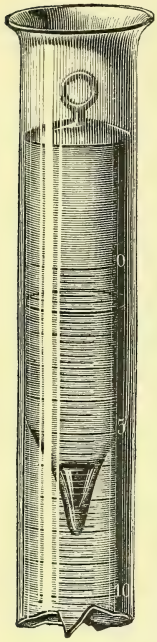
The equivalence of an element varies in different compounds, *e. g.* phosphorus, which is trivalent in the chloride PCl_3, and pentavalent in the chloride PCl_5. Again, chlorine is usually monovalent, but in chloric acid it appears to be heptavalent. In the table below, the equivalence of each element in its most stable compounds is given.

Table of the more important Elements arranged according to their Equivalency.

Monovalent.	Divalent.	Trivalent.	Tetravalent.	Pentavalent.	Hexavalent.
Hydrogen	Beryllium	Boron	Carbon	Nitrogen	Sulphur
Lithium	Magnesium	Aluminium	Silicon	Phosphorus	Chromium
Sodium	Calcium	Arsenic	Titanium	Vanadium	Selenium
Potassium	Zinc	Antimony	Zirconium		Tellurium
Silver	Strontium	Gold	Tin		
Fluorine	Cadmium		Platinum		
Chlorine	Barium				
Bromine	Mercury				
Iodine	Lead				
	Oxygen				
	Nickel				
	Cobalt				

ERBIUM. A metal discovered by Mosander in 1843. It occurs together with yttrium in gadolinite. Its oxide, E_2O_3, and its chloride and sulphate have been prepared.

ERDMANN'S FLOAT. This useful little instrument, invented, as its name implies, by Erdmann, is used to ensure accuracy in the readings of Mohr's burette.



It is in the form of an elongated glass bulb, loaded with a globule of mercury at the bottom, in the same way as a hydrometer, and with a glass hook at the top, by means of which it can be placed in or removed from the liquid in the burette. In the best forms of float, the elongation containing the mercury is sealed off from the rest of the float. The float has a circular mark scratched by a diamond, running round the middle, which, when the instrument is placed in the fluid in the burette, should correspond with the graduation on the burette at which the fluid stands. The actual height of the fluid in the burette is of no consequence, since, if the operation be commenced with the line on the float opposite the 0 graduation on the burette, the same proportional division is always maintained. It is most essential that, when the fluid is being drawn off, the float should accompany it in its descent without wavering, and that the circular mark upon it should always be parallel to the graduations of the burette. Another condition is, that when the float has been pressed down in the fluid of the closed burette it should slowly rise again.

EREMACAU'SIS. Slow burning; decay. This expression was applied by Liebig to the peculiar decomposition which moist organic matter undergoes, when freely exposed to the air, by the oxygen of which it is gradually burned or destroyed, without any sensible elevation of temperature. See PUTREFACTION.

ER'GOT. *Syn.* ERGOTA, ERGOT OF RYE. The sclerotium of *Claviceps purpurea*, Tulosne, produced between the pales and replacing the grain of *Secale cereale.*

Ergot is about 1 in. long, arched, furrowed on one side; violet purple externally, whitish purple within; odour peculiar and meat-like. Rubbed with potash it smells of methylamin. Ergot has been made the subject of numerous chemical investigations, but it cannot be said that any one has yet succeeded in extracting from it an active principle representing the full action of the drug; many claims have been made in this direction, but none of these have been able to sufficiently sustain their position, or obtain recognition as the true active principle of ergot. It is known, however, that ergot contains a number of substances, such as acids and alkaloids of very unstable character, and it is to these and their products of decomposition that the drug undoubtedly owes its action.

Ergot of rye deteriorates greatly by age, being subject to the attacks of a description of acarus resembling the cheese mite, but much smaller, which destroys the whole of the internal portion of the grain, leaving nothing but the shell, and a considerable quantity of excrementitious matter. To prevent this the ergot should be well dried, and then placed in bottles or tin canisters, and closely preserved from the air. The addition of a few cloves, or drops of the oil of cloves, or strong acetic acid, or a little camphor or camphorated spirit of wine, will preserve this substance for years in close vessels. M. Martin proposes to steep the dry ergot in strong mucilage, and then to dry it on a sheet of white iron. This operation he repeats once or oftener, and finally preserves the prepared and thoroughly dried ergot in a well-corked glass flask ('Jour. de Chimie Méd.'). The wholesale druggists generally keep it in well-covered tin canisters or tin boxes.

N. B. Gionovié ('Zeitschr. des Oesterr. Apoth. Ver.,' 1876, 126) states he has used the following process with the best success. A small quantity of ether is dropped on the ergot contained in a bottle, and the latter closed with a well-fitting stopper. The addition of ether is repeated every time the bottle is opened.

Ergot of rye is much used to restrain uterine hæmorrhage and to accelerate the contraction of the uterus in protracted labour. It is also much used as an emmenagogue.—*Dose.* To facilitate labour, 20 to 30 gr., either in powder or made into an effusion; repeated at intervals of 20 or 30 minutes until 3 or 4 scr. have been taken. In other cases (leucorrhœa, hæmorrhages, &c.) the dose is 5 to 12 gr. three times daily, for a period not longer than a week or ten days at a time.

M. Tancret states that he has succeeded in obtaining an alkaloid from ergot of rye, which he names *ergotinine.* The isolation of ergotinine is said to be attended with great difficulty, owing to its great tendency to undergo spontaneous changes, a short contact with the air being sufficient to decompose it; a circumstance which may perhaps help to explain the rapid change that the powder ergot experiences. Professor Dragendorff, however, refuses to admit that ergotinine is the active principle of ergot, or that it is a distinct chemical substance. He ascribes the therapeutic power of the drug mainly to *sclerotic acid,* which body, after various unsuccessful attempts, he has obtained from ergot, with certain other determinate compounds, by the following process:—"Very finely powdered ergot is exhausted with distilled water, the solution concentrated *in vacuo,* and the residuary liquid mixed with an equal volume of 95% alcohol. This causes the precipitation of a peculiarly shiny substance (scleromucin), together with a portion of the salts, and the greater part of the suspended fatty matter. The mixture having been allowed to stand on ice for 24 to 48 hours, it is filtered, and the filtrate mixed with a further quantity of 95% alcohol, sufficient to precipitate all the sclerotic acid in combination with the bases (chiefly as calcium sclerotate). The separation of the precipitate is promoted as before, by placing the mixture on ice for some days. This causes the

deposited mass, which has a brownish colour, to adhere firmly to the walls of the vessel, so as to permit the supernatant liquid to be easily poured off. The precipitate is kneaded with 80%, and immediately thereafter dissolved in a sufficient quantity of 40% alcohol, when the remainder of the scleromucin and another large portion of the foreign salts are left behind. The filtered liquid is now mixed with absolute alcohol, whereby sclerotic acid is precipitated in conjunction with certain bases and other substances. The impure product, when carefully dried over sulphuric acid, was found on analysis to contain 8·5% of potassium, about 0·36% of calcium, 4·3% of sodium, 2·74% of phosphoric acid, or altogether 12·9% of ash.

"The greater part of these admixtures may be removed, and the sclerotic acid obtained free, by adding before the final precipitation with absolute alcohol a considerable quantity of hydrochloric acid (for every 100 c.c. of solution 5—6 grms. of the acid, sp. gr. 1·100), allowing to stand at ordinary temperature for a few hours, and then proceeding to precipitate. In this manner the amount of ash may be brought down to 3%, and by repeated solution, addition of acid, and precipitation, it may further be reduced to less than 2% or 3%. A more complete purification is difficult and hazardous, because every addition of hydrochloric acid causes the decomposition of a small quantity of sclerotic acid, while at the same time a portion of the latter is lost by remaining in solution.

"The resulting product, although not chemically pure, is nevertheless physiologically pure, as it always produces constant and identical results, no matter from what sample of (good) ergot it was obtained.

"Good ergot contains about 4% to 4·5% of the acid, although samples are met with which contain scarcely 1·5% to 2% (from 'New Remedies').

Frogs are stated to have been thrown into a state of palsy by the hypodermic injection of 0·02 to 0·04 grm. of sclerotic acid.

See DECOCTION, EXTRACT, INFUSION, OIL, TINCTURE, &c.

ER'GOTIN. *Syn.* ERGOTINA, L. *Prep.* 1. (*Bonjean's.*) Powdered ergot is exhausted with cold water, by displacement, and the resulting solution is heated in a water-bath to about 200° F., and filtered; the filtered liquor is then evaporated to the consistence of a syrup, and when cold, is treated with rectified spirit, in considerable excess, to precipitate its gummy matter; after repose, the clear portion is decanted, by the heat of a water-bath, to the consistence of a soft extract. —*Prod.*, 15%. According to M. Bonjean, this preparation possesses all the 'hæmostatic' without any of the 'poisonous' qualities of ergot. It has a reddish-brown colour, a bitter taste, and an odour somewhat resembling that of roasted meat. Its aqueous solution is red, limpid, and transparent.—*Dose*, 4 to 10 gr., either made into a pill or dissolved in water.

2. (B. P.) Liquid extract of ergot, 4 oz.; rectified spirit, 4 oz. Evaporate the extract by a water-bath to a syrup, when cold mix with the spirit, let it stand for ½ hour, then filter, and evaporate the filtered liquid to the consistence of a soft extract.

3. (*Wigger's.*) Powdered ergot is first digested in ether, to remove the fatty matter, and then in boiling alcohol; the alcoholic tincture is evaporated, and the resulting extract treated with water; the undissolved portion, dissolved in hot alcohol and filtered, yields pure ergotin by gentle evaporation.—*Prod.*, 1¼%. It has a brownish-red colour; is resinous, acrid, bitter, insoluble in water and ether, soluble in alcohol, and poisonous. It evolves a peculiar odour when warmed. Its therapeutical action has not been determined. See EXTRACT.

ER'RHINES. *Syn.* ERRHINA, L. Substances applied to the pituitary membrane of the nose, for the purpose of producing an increased discharge of nasal mucus. When they are given to excite sneezing, they are called STERNUTATORIES or PTARMICS. Asarabacca, euphorbium, several of the *labiatæ* (herbæ *vel* flores), sal-ammoniac, powdered sugar, subsulphate of mercury, tobacco, and white hellebore, are the principal substances of this class.

Errhines act as local irritants, and are occasionally employed in chronic affections of the eyes, face, ears, and brain; as in amaurosis, ophthalmia, deafness, weak sight, headache, &c.

Errhine, Al'um. *Syn.* ERRHINUM ALUMINIS, L. *Prep.* (*Radius.*) Alum and Armenian bole, of each, 1 dr.; kino, ½ dr.; red oxide of iron, 2 dr. (all in powder); mix and triturate. In bleeding at the nose. A little is snuffed up the nostrils.

Errhine, Hæmostat'ic. *Syn.* ERRHINUM HÆMOSTATICUS, L. *Prep.* From powdered catechu, 1 dr.; opium, 5 gr.; sugar, 2 dr. As the last.

ERUPTIONS (of the Skin). For brevity and convenience, these cutaneous affections may be divided into 5 classes:

Eruptions, Pap'ular. *Syn.* DRY PIMPLES. In these the surface is raised into little elevations or pimples, which sometimes show themselves on the surface, and at others are only appreciable by the touch. They are usually accompanied with a greater or less degree of cutaneous irritation and troublesome itching, in attempting to relieve which they are frequently converted into disagreeable and painful sores and excoriations, which are often difficult to heal.

Eruptions, Parasitic. These are due to the presence of minute parasites, animal and vegetable. See ITCH.

Eruptions, Pus'tular. *Syn.* MATTERY PIMPLES. These are distinguished by the pimples (pustules) containing an opaque yellow fluid or matter (pus, lymph). "They are generally developed on a ground of inflamed skin; and the degree of this inflammation of the skin is the basis of their division into two groups, termed technically 'IMPETIGO' and 'ECTHYMA.' The former presents the slighter degree of inflammation, and, sometimes, there is scarcely any redness of the skin; the latter is always accompanied by considerable inflammation and redness." "The little bubbles attain their full size in the course of 2 or 3 days, and either dry up without breaking or more frequently burst and then dry, forming a hard crust, which offers considerable variety of colour, being sometimes yellowish, sometimes brownish, and

sometimes almost black." The latter form is popularly known as 'crusted tetter.' In ecthyma the pustules "are generally of the size of a split pea, and surrounded at their base by a broad halo of redness. They are usually separate, not clustered like impetigo, scattered over various parts of the body, and followed either by a hard black crust or by a sore."

Eruptions, Sca'ly. *Syn.* DRY TETTER. This is a form of inflammatory condition of the true skin (DERMA), which commonly makes its appearance as a small dull red, salmon-red, or liver-coloured spot, slightly raised above the level of the surrounding skin, constituting a broad, flat, pimple-like prominence, about the size of a split pea. Upon the surface of this prominence the scarf-skin becomes slightly roughened, and after a little while a very distinct but circular scale is produced, which increases in thickness by the addition of fresh layers, and after assuming various colours in different varieties of the disease, ultimately separates and falls off, either leaving a permanently bare surface, or being followed by crops of other like scales, which also fall off, and are replaced in rapid succession.

Eruptions, Vesic'ular. *Syn.* WATERY PIMPLES. These consist of little vesicles or bladders, filled with a small quantity of a transparent and colourless liquid. They result from a similar action to that which produces ordinary blisters. Inflammation is excited in the sensitive skin by an inward or outward cause, and the inflamed vessels pour out the watery part of the blood, and so raise the scarf-skin from off the sensitive layer, in the form of a small dome, which in some situations is conical, in others a segment of a sphere. They present great variety in point of number and size; some are so minute as to be scarcely discernible without close inspection, whilst others increase to the magnitude of a hen's egg. They are numerous in the inverse ratio of their size; the smaller ones being very abundant, and the larger ones scanty and few.

Many of these diseases depend upon constitutional causes; others require careful discrimination and necessitate the exercise of medical skill.

ERVALEN'TA. The meal of lentil (*Ervum lens*, Linn.), variously doctored with other substances. In some cases the article sold under the name does not contain a particle of lentil meal.

Prep. 1. (Paris Ervalenta.) Indian-corn meal (fine), and bean flour, of each, 14 lbs.; salt and sugar, of each, 1 lb.; mix, and pass the compound through a sieve.

2. (*Warton's.*) Lentil powder, 1 part; durra or Turkey millet-flour (*Sorghum vulgare*), 2 parts. Some persons assert that it contains a large quantity of the flour of Indian corn. See LENTILS and REVALENTA.

ERYN''GO. *Syn.* ERYNGIUM, L. The root of the *Eryngium campestre*, a plant common in middle and southern Europe. It is sweet, aromatic, and tonic, and formerly enjoyed much repute in gonorrhœa, suppressed menstruation, and visceral obstructions generally, especially those of the gall-bladder, liver, and uterus. Candied eryngo (ERYNGIUM CONDITUM, ERYNGII RADIX CONDITA), according to Lindley, "has the credit of being a decided aphrodisiac," and has a considerable sale. *Eryngium aquaticum* (bitter snake-weed) and *E. maritimum* (sea eryngo, sea holly) furnish the eryngo of the Ph. U. S. See CANDYING.

ERYSIPELAS. *Syn.* ST ANTHONY'S FIRE; THE ROSE (Scotch).

Def. Inflammation of the integument tending to spread indefinitely by means of the lymphatics and lymph spaces of the part.

Little is known as to the exact cause of this disease, but it is believed to be the result of the operations of an organism, and is communicable by inoculation.

Predisposing Causes are:—(1) Constitutional predisposition; (2) disease of the liver and kidneys; (3) wounds; (4) sex—women are more liable than men, especially at the menstrual period; (5) intemperance and want of proper food. Dirt, bad ventilation, and overcrowding greatly favour erysipelas.

Symptoms. Fever, malaise, loss of appetite, followed in a few hours by inflammation of the skin in some part of the body, starting from some wound or scratch or sore, or the junction of mucous membranes with the skin by the angle of the mouth or eye, the external auditory meatus, or the anus. The inflamed skin is bright red in colour with sometimes a yellowish tinge, the redness advancing in all directions; the skin is œdematous, and pressure with the finger leaves a lasting mark.

There are 3 or 4 recognised varieties of erysipelas, but a description of them would be out of place here.

General Treatm. Gentle purgatives. Tincture of perchloride of iron in 40-minim doses every 4 hours. Tincture of aconite in ½-drop doses every ¼ hour for 1 or 2 hours, then hourly till the skin is moist and the temperature falls. Great care is required in the use of this drug to avoid dangerous depression. A nourishing *liquid* diet, beef tea, eggs and milk, &c., is essential; solid food is inadmissable. Stimulants are usually required.

Local Treatm. Warmth; fomentations and packing in cotton wool. Poultices should *not* be used. Extract of belladonna made into a paint with an equal part of glycerine and perchloride of iron has been used with success as local applications.

It must be remembered that erysipelas in any form is a dangerous disease, especially in old people, and medical advice should be at once sought.

ERYTHORE'TIN. *Syn.* RED RESIN OF RHUBARB. A yellow or reddish-yellow substance, forming one of the three resins found by Schlösberger and Dœpping in rhubarb. It is very soluble in alcohol; less so in ether; with ammonia and potassa it forms soluble compounds of a rich purple colour. See RHUBARB.

ERYTH'RIC ACID. *Prep.* The lichen *Rocella tinctoria* (Canary or herb-archil) is boiled with milk of lime, and the filtered solution precipitated with hydrochloric acid; the dried precipitate is dissolved in warm alcohol, and filtered; as the solution cools, crystals of erythric acid are deposited.

Prep., &c. Feebly acid; colourless; inodorous; scarcely soluble in water; soluble in alcohol and

ether; chloride of lime turns its solutions of a blood-red colour.

ERYTH'RINE, Amarythrine, Erythriline, Pseudo-erythrine, and Telerythrine. Substances obtained by Kane and Heeren from *Rocella tinctoria, Parmelia rocella, Leconara tartarea,* &c. They are of little practical importance.

ESCHAROT'ICS. *Syn.* Escharotica, L. Substances that destroy the texture of living organic bodies, with the production of an 'eschar' or 'scab.' Escharotics have been divided into two classes—*mechanical* and *chemical.* Among the former are actual cauteries, as a heated iron, moxas, &c.; among the latter are all those substances commonly known as caustics. Some writers have subdivided chemical escharotics into eroding escharotics, as blue vitriol, red precipitate, burnt alum, &c.; and caustic escharotics, as lunar caustic, pure potassa, strong sulphuric acid, nitric acid, &c.; but these distinctions possess little practical value. "In cauterising with a heated iron, this should be at a white heat, as, at this temperature, it occasions less pain to the patient, from its causing an immediate death of the parts to which it is applied." "The surrounding surface should be protected by some non-conductor of heat, but not by wet paper or cloth, as the sudden extrication of steam will produce a blistered surface around the burn, and will much increase the pain" (*Dr R. E. Griffith*). See Caustic, Solution, &c.

ES'CULENTS. Substances used for food. The more important esculents are noticed under their respective heads.

ESCU'LIC ACID. A peculiar acid found by M. Bussy in the bark of the horse-chestnut. It is but little known, and has not been applied to any use.

ESERIDINE. Eseridina. Besides physostigmine, or eserine, and the less known calabarine, there is, it is stated by Messrs C. Böhringer and Sons, of Mannheim, yet another base in Calabar beans, for which the name eseridine is proposed. This is a white crystalline powder, which, however, can be got in large transparent crystals; the fusing point is 132° C. (270·6° F.), and it is only slightly soluble in ether. According to Dr Eber, eseridine is far less actively poisonous than eserine, but (in this respect resembling calabarine rather closely) it exercises a tetanic action upon the spinal cord, and acts powerfully upon the intestinal system, inducing very abundant mucous discharges. The formula of the new base is given as $C_{15}H_{23}N_3O_3$, and it therefore differs from the eserine by the elements of an additional molecule of water only. This is given up when the base is heated with a mineral acid, and physostigmine itself is the result of the reaction.

ESERINE. See Physostigmine.

ESPRIT. [Fr.] Spirit. This term is commonly applied to alcoholic solutions of the essential oils, and to various odorous and aromatic essences sold by the perfumers and druggists as articles of toilet. See Essence, Spirit, &c.

ES'SENCE. *Syn.* Essentia, L. The active and characteristic portion of a substance, or that on which its most remarkable properties depend. The term has been very loosely applied to various preparations presumed to contain these essential principles or qualities, disencumbered of grosser matter. Modern systematic writers generally restrict its application to the volatile oils obtained from vegetable substances by distillation, or to a strong solution of them in alcohol. In *pharmacy* and *perfumery,* the word 'essence' is applied to concentrated preparations that differ vastly from each other. Thus, concentrated infusions, decoctions, liquors, solutions, and tinctures are frequently called 'essences' by those who vend them; but the term 'fluid extracts' would be more appropriate, if those already mentioned are not deemed sufficiently showy and attractive. We shall here confine ourselves to a brief notice of the principal compound essences, or those that undergo some preparation beyond being merely extracted from vegetables by distillation along with water. The latter will be considered under the article Oil.

The concentrated preparations of the pharmaceutist, termed 'essences,' are mostly prepared by digesting the active ingredient or ingredients in rectified spirit of wine, either with or without the addition of a certain portion of water; or they are extemporaneously formed by dissolving a portion of the essential oil of such substances in the spirit. In this way are made the essences of lavender, musk, ginger, &c. When it is desired only to obtain the aromatic and volatile portion of the ingredients, the latter are usually digested in the spirit for a few days, and then submitted to distillation, when the alcohol comes over loaded with aromatic essential oil, or other volatile matter. In this way are prepared most of the fragrant essences of the perfumer and druggist, when simple solution of the essential oils in alcohol is not resorted to. In many cases the active principles of the ingredients are partly volatile and partly fixed, or at least do not readily volatilise at the temperature at which alcohol distils over. This is the case, for instance, with the active portion of ergot and Jamaica ginger. In such cases digestion alone should be adopted. When the principles of organic substances, of which it is desired to obtain a concentrated solution, are resinous or oily, or little soluble in weak spirit (which is mostly the case), the strongest rectified spirit of wine should alone be employed. In the preparation of essences without distillation, the method by percolation or displacement is preferable to that of simple maceration and expression, when the nature of the ingredients and other circumstances render it applicable, as it is not only more economical, but a more concentrated solution may thereby be obtained. At the same time, however, the reader should remember that this mode of operating requires much greater experience and skill to ensure success than the former method. Clumsiness of manipulation is the common cause of the failures which are so frequently met with in the preparation of these articles.

The ingredients for the preparation of essences must undergo the same operations of bruising, powdering, or slicing, as directed under 'Tincture,' previous to digestion in the spirit, or other menstruum; and the length of time they should be allowed to infuse, when this method alone is

adopted, should not be less than ten days; but this time may be advantageously extended to a fortnight, or even longer. During the whole of this period frequent agitation should be employed, and when the ingredients are so bulky as to absorb the whole of the fluid, the vessel which contains them should be securely fastened by a bung or stopper covered with bladder, and inverted every alternate day. By this means every portion of the ingredients will be equally exposed to the action of the menstruum. In all such cases the method of displacement, or percolation, is preferable. For the essences used as perfumes and for flavouring, not only must the spirit be perfectly tasteless and scentless, but it must also be quite devoid of colour.

The following formulæ embrace most of the essences met with in the shops. Those not found among them may be readily prepared by applying the general directions given above, or by employing the formula given for the preparation of the essence of some similar substance, merely varying the characteristic ingredient. Thus, were it desired to form an essence of ambergris or of myrrh, and no formulæ could be found for these preparations, the tyro would consider in what menstruum the active principles of these substances were most soluble. This, he would immediately see by reference to their properties, is rectified spirit of wine. He would next have to decide on the proper strength of his essence. In this he must be guided either by the strength of the like preparations of other makers, or by his own judgment of what would be useful, novel, or convenient. Suppose he decided that his essence should represent 1-10th of its weight of the solid ingredient. He would then take 2 oz. of ambergris or myrrh, and 20 oz. of rectified spirit, which he would digest together for 10 days or a fortnight in the manner described above. Had the required preparation been an essence of senna (for example), he would probably recollect, or might easily ascertain by reference, that the active properties of senna are soluble in both water and weak spirit. Then, to make an essence 4 times as strong as the tincture of the pharmacopœia, 7 oz. of senna and 1 pint of proof spirit should be employed, with due digestion, as before (see directions under TINCTURE). The same applies to other preparations. See CONCENTRATION, DECOCTION, INFUSION, LIQUOR, SPIRIT, TINCTURE, &c.

Essence of Ac′onite. *Syn.* ESSENTIA ACONITI, L. *Prep.* From aconite (herb, dried and powdered), 8 oz.; rectified spirit, 16 oz.; macerate for 4 days at a temperature of 68° F., press, and strain; the marc or residuum is again macerated with (a little) spirit, and pressed as before, so that the weight of the mixed tinctures may amount to double that of the herb.—*Dose*, 3 to 6 drops. See TINCTURE.

Essence of All′spice. *Syn.* ESSENCE OF PIMENTO; ESSENTIA PIMENTÆ, L. *Prep.* From essential oil of pimento or allspice, 1 fl. oz.; strongest rectified spirit of wine, 1 pint; agitate until perfectly united, and the next day decant the clear portion, if there is any sediment. Used to make pimento water, and by cooks and confectioners as a 'flavouring.'

Essence of Al′monds. *Syn.* ESSENCE OF BITTER ALMONDS, E. OF PEACH KERNELS, E. OF RATAFIA, E. OF NOYEAU, QUINTESSENCE OF N., ALMOND FLAVOUR; ESSENTIA AMYGDALÆ, E. A. AMARÆ, L. *Prep.* 1. From essential oil of almonds, as the last.

2. (*Pereira.*) Essential oil of almonds, 1 fl. oz.; rectified spirit, 7 fl. oz.

Uses, &c. It is added to wine, cordials, perfumery, pastry, &c., to impart an agreeable nutty flavour or aroma. It is also employed to prepare cherry-laurel, peach-kernel, and bitter-almond water. A large quantity is consumed by the confectioners, and by wine merchants to 'improve' their sherries, and to give Cape wine a sherry flavour. It should be used in very small quantities, as it is very powerful, and, in quantity, poisonous. A few drops are sufficient for several pounds of pastry. The first formula is that used in trade. The second is sometimes used by the druggists, and is occasionally vended under the name of 'CONCENTRATED ESSENCE OF BITTER ALMONDS,' &c. The directions for purifying the almond oil from hydrocyanic acid before dissolving it in the spirit, given in more than one recent book of receipts, are absurd, as in this way the oil loses much of its characteristic odour and flavour, and by keeping gradually becomes nearly destitute of both. See ESSENTIAL OIL.

Essence of Am′bergris. *Syn.* ESSENTIA AMBRÆ-GRISSÆ, E. A. SIMPLEX, TINCTURA A. CONCENTRATA, L. *Prep.* 1. Ambergris (cut very small), 5 dr.; rectified spirit, 1 pint; place them in a strong bottle or tin can, secure the mouth very firmly, and expose it to the heat of the sun, or in an equally warm situation, for 1 or 2 months, frequently shaking it during the time; lastly, decant and filter through paper.

2. (*Guibourt.*) Ambergris, 1 dr.; rectified spirit, 3 oz.; digest 10 or 12 days.

3. (*Redwood.*) Ambergris, 2½ dr.; rectified spirit, 1 pint; macerate for 14 days. Chiefly used as an element in other perfumes. The first is the formula employed by the London houses.

Essence of Ambergris and Musk. *Syn.* CONCENTRATED TINCTURE OF A. AND M.; E. AMBRÆGRISSÆ (ODORATA), E. A. ET MOSCHI, E. REGIA, L.; ESSENCE ROYALE, Fr. *Prep.* 1. Ambergris (cut small), ¾ oz.; 1 or 2 fresh-emptied musk-pods (or musk, 12 gr.); rectified spirit, 1 pint; proceed as in No. 1 (*above*).

2. Ambergris, 2½ oz.; bladder musk, ½ oz.; spirit of ambrette (purple sweet sultan), 1 gall.; as last.

3. Ambergris, 2½ oz.; bladder musk, ½ oz.; spirit of ambrette, 1 gall.; as before. The fragrance of the above, especially of the last two, is very powerful, and is much esteemed.

4. Ambergris, ½ oz.; musk and lump sugar, of each, ¼ oz.; triturate together in a wedgwood-ware mortar, adding oil of cloves, 20 drops; true balsam of Peru, 30 drops, and enough essence of jasmine or tuberose to convert it into a perfectly smooth paste; then put it into a strong bottle with rectified spirit, 1 quart; observing, before adding the whole of the last, to rinse the mortar out well with it, that nothing may be lost; lastly digest for 6 or 8 weeks, as directed in No. 1 (*above*).

5. Ambergris, 4 dr.; musk, 1½ dr.; sand, 3 oz.; triturate, then add of oil of cinnamon, 1 dr.; oil of rhodium, ½ dr.; essence of roses and eau fleurs d'orange, of each, ¼ pint; rectified spirit, 1½ pints; digest as before (or not less than 14 days), and decant and filter. The last two are very fine, though inferior to Nos. 2 and 3.

6. To the last (No. 5), add civet, 1 dr.; salt of tartar, 3 dr.; and an additional pint of rectified spirit. Inferior to the above, but cheaper.

Obs. Essence of ambergris is used as a perfume, and is added in small quantities to sweet-scented spirits and wines, to improve their flavour and aroma. A very small quantity of any one of them added to lavender water, eau de Cologne, tooth-powder, hair-powder, wash-balls, or a hogshead of claret, communicates a delicious fragrance. See AMBERGRIS and ESSENCE ROYALE (*below*).

Essence d'Ambrette. [Fr.] *Syn.* ESSENCE OF MUSK-SEED, SPIRIT OF M.-S.; ESPRIT D'AMBRETTE, Fr. *Prep.* 1. Musk-seed (ground in a clean pepper-mill), 1¼ lbs.; rectified spirit, 3 pints; digest for 3 or 4 weeks in a warm place, and filter.

2. Musk-seed, 4 lbs.; rectified spirit, 1 gall.; digest 10 days, add water, 2 quarts, and distil over 1 gall. Very fine.

Essence of Ammoni'acum. *Syn.* CONCENTRATED TINCTURE OF AMMONIACUM; ESSENTIA AMMONIACI, TINCTURA A. CONCENTRATA, L. *Prep.* 1. Ammoniacum (in tears), 1 lb., is bruised in a very cold marble mortar with half its weight of coarse and well-washed siliceous sand or powdered glass, and rectified spirit, ½ pint, gradually added; the trituration is continued until the whole is reduced to a smooth paste, and is then placed in a wide-mouthed bottle, and spirit of wine, 1½ pints, further added; the whole is then digested together for a week with constant agitation, and after sufficient repose to settle, the supernatant transparent liquid is decanted into another bottle for use.

2. Gum-ammoniacum, 1 lb., is reduced to a cream with boiling water, ¾ pint; as soon as the mixture has cooled a little, it is placed in a strong bottle, and rectified spirit of wine, 1¼ pints, is cautiously added; the mixture is then corked down close, and the whole macerated for a few days; the bottle is next placed in a moderately warm situation, that the sediment may subside, after which the clearer portion is poured off through flannel into another bottle.

Obs. This preparation is used as a substitute for the gum in substance, for extemporaneously preparing emulsion of ammoniacum, mixture of a., &c. It is represented to possess fully the same amount of medicinal virtue as an equal weight of the solid gum, on which account it has a considerable sale. The product of the first formula, when well managed, is a beautiful pale brownish-coloured, transparent tincture; that of the second is milky and less sightly. The preparation generally sold under the name of 'CONCENTRATED ESSENCE OF AMMONIACUM' (ESSENTIA AMMONIACI CONCENTRATA, L.), and represented as twice as strong as the gum in substance, is generally prepared by the first formula given above for ESSENCE OF AMMONIACUM. A stronger article may be prepared by a similar process by using 1 lb. of ammoniacum to a pint of the strongest rectified spirit. As, however, a clear liquid at this strength is somewhat difficult to produce, it is very seldom attempted by the druggists; they therefore generally content themselves with sending out the liquid at half the professed strength, leaving the label to confer the additional concentration. See AMMONIACUM.

Essence of Ancho'vies. *Syn.* ESSENTIA CLUPEÆ, L. *Prep.* 1. Anchovies, 1 lb., are 'boned,' reduced to a pulp in a wedgwood-ware or marble mortar, and passed through a clean hair or brass-wire sieve: meanwhile the bones and other portion that will not pass through the sieve are boiled with water, 1 pint, for 15 minutes and strained; to the strained liquor, salt and flour, of each, 2½ oz., together with the pulped anchovies, are added, and the whole simmered for 3 or 4 minutes, when the vessel is removed from the fire, and as soon as the mixture has cooled a little, strong pickling vinegar, ½ pint, is mixed in; it is then bottled, and the corks tied over with bladder, and either 'waxed' or 'capsuled.'—*Prod.*, 3 lbs. (nearly).

2. Anchovies, 7 lbs.; water, 9 pints; salt and flour, of each, 1 lb.—*Prod.*, 20 lbs.

3. To the last add of Cayenne pepper, ¼ oz.; the peel of a lemon (grated), and mushroom catsup, 4 oz. Very savoury.

4. From British anchovies (pickled sprats) or young pilchards, along with herring liquor, or the drainings of anchovy barrels.

Use, &c. As a sauce and condiment; when well prepared, it has a fine flavour. That of the shops is usually coloured with Venetian red or Armenian bole. An infusion of cochineal or a little annotta would form a more appropriate colouring, and would be perfectly harmless. See ANCHOVY and SAUCE.

Essence of Angel'ica. *Syn.* ESSENTIA ANGELICÆ, L. *Prep.* (*Van Mons.*) Angelica root (bruised), 1 part; rectified spirit, 8 parts; water, 16 parts; digest, and distil over 6 parts. Stomachic, carminative, and alexipharmic.—*Dose*, 1 to 2 spoonfuls.

Essence of An'iseed. *Syn.* ESSENTIA ANISI (B. P.), L.; ESPRIT D'ANISE, Fr. Oil of anise, 1 part; rectified spirit, 4 parts; mix (B. P.). Stimulant, aromatic, and carminative.—*Dose*, 10 to 20 minims. Used also to flavour liqueurs, and to make aniseed water. See SPIRIT.

Essence, An'odyne. *Syn.* ESSENTIA ANODYNA, L. *Prep.* 1. Hard aqueous extract of opium (in powder), 1 dr.; powdered cinnamon, ½ dr.; rectified spirit, 1 fl. oz.; digest a week.—*Dose*, 5 to 20 drops.

2. Extract of henbane (recent), 5 dr.; rectified spirit, 2 fl. oz.; as last.—*Dose*, 10 to 30 drops. Narcotic, sedative, and antispasmodic. Both are excellent preparations.

Essence, Antihyster'ic. *Syn.* ESSENTIA ANTIHYSTERICA, L. *Prep.* 1. Cyanuret of potassium, 3 gr.; powdered sugar, 1 dr.; rectified spirit and eau d'orange, of each, 4 fl. dr.; agitate together until dissolved. *Dose*, 10 to 20 drops in pure water; in hysteria, gastrodynia, &c. See DRAUGHT (Antihysteric).

2. (P. Cod.) Resembles FŒTID SPIRIT OF AMMONIA (which *see*).

Essence of Ap'ple. *Syn.* SOLUTION OF VALERIANATE OF AMYL; ESSENTIA POMI ODORATA, L.

Prep. From apple oil (valerianate of oxide of amyl), as ESSENCE OF ALMONDS. Used to flavour liqueurs and confectionery.

Essence of Ar'nica. *Syn.* ESSENTIA ARNICÆ, E. A. FLORUM, TINCTURA A. E. CONCENTRATA, L. *Prep.* (Ph. Baden, 1841.) From arnica flowers, as ESSENCE OF ACONITE. It represents half its weight of herb.

Essence, Aromat'ic. *Syn.* ESSENTIA AROMATICA, L. *Prep.* From hay saffron, 1 dr.; and rectified spirit, 6 fl. dr.; digested together; to the filtered tincture is added oil of cinnamon and powdered white sugar, of each, 1 dr.; ether (rect.), 2 fl. dr.; oil of nutmeg and essence of ginger, of each, $\frac{1}{2}$ dr.; after agitation and a few days' repose the clear portion is decanted into a stoppered phial.—*Dose,* 5 to 15 drops on sugar or in a glass of wine or weak spirit; in choleraic diarrhœa, spasms, &c.

Essence of Bark. *Syn.* ESSENTIA CINCHONÆ, E. CORTICIS C., L. *Prep.* 1. Resinous extract of yellow bark, 4 dr.; rectified spirit, $1\frac{1}{2}$ fl. oz.; tincture of orange peel, $\frac{1}{2}$ fl. oz.; acetic acid (Ph. L.), 1 fl. oz.; digest a week.

2. Disulphate of quinine, $\frac{1}{2}$ dr.; resinous extract of bark, 2 dr.; rectified spirit, 2 fl. oz.; as before.—*Dose,* 12 drops to a teaspoonful; as a febrifuge and tonic.

Essence of Beef. *Syn.* ESSENCE OF RED MEATS, &c. *Prep.* 1. From lean beef (chopped small), 1 lb.; water, $\frac{1}{2}$ pint; place them in a bottle which they will only half fill, and agitate them violently for $\frac{1}{2}$ hour; then throw the whole on a sieve, and receive the liquid in a jug; next boil the undissolved portion in water, 1 pint, for 20 minutes; strain, mix the decoction with the cold infusion, evaporate the liquid to the consistence of a thin syrup, adding spice, salt, &c., to taste, and pour the essence, whilst boiling hot, into bottles, jars, or (still better) tin cans, which must then be at once hermetically corked, sealed, or soldered up, and stowed away in a cold place. In this state it will keep a long time (*Brande*).

2. (*Ellis.*) Take of lean beef (sliced), a sufficient quantity to fill the body of a porter bottle; cork it up loosely, and place it in a pot of cold water, attaching the neck, by means of a string, to the handle of the pot; boil for $1\frac{1}{2}$ to 2 hours, then decant the liquid and skim it. Spices, salt, wine, brandy, &c., may be added as before. Highly nutritious.

Essence of Ber'gamot. See OIL (Volatile).

Essence, Bitter. *Syn.* ESSENTIA AMARA, L. *Prep.* (Ph. Den.) Wormwood, 4 parts; gentian root, bitter orange peel, and blessed thistle, of each, 1 part; rectified spirit, 45 parts; digest a week. Tonic and stomachic.—*Dose,* $\frac{1}{2}$ dr. to 2 dr.

Essence of Calum'ba. *Syn.* ESSENTIA CALUMBÆ, L. See INFUSION OF CALUMBA.

Essence of Cam'phor. *Syn.* CAMPHOR DROPS, LIQUOR OF CAMPHOR, CONCENTRATED ESSENCE OF C., CONCENTRATED SOLUTION OF C., CONC. CAMPHOR JULEP; ESSENTIA CAMPHORÆ, LIQUOR C., L. C. CONCENTRATUS, L. *Prep.* 1. Camphor (clean), $4\frac{1}{2}$ oz.; rectified spirit, 1 gall.; dissolve. This forms the 'ESSENCE OF CAMPHOR' and 'LIQUOR CAMPHORÆ' of the wholesale houses. About $\frac{1}{2}$ fl. dr. added to $7\frac{1}{2}$ fl. dr. of cold distilled water forms (by agitation) a transparent aqueous solution of camphor, fully equal in strength to the filtered 'MISTURA CAMPHORÆ' (camphor julep) of the Ph. L. The above made with weaker spirit forms the 'spirit of wine and camphor' of the shops.

2. Camphor, 1 oz.; rectified spirit, 10 oz. (by weight); dissolve. This forms the 'CONCENTRATED ESSENCE OF CAMPHOR' of the wholesale druggists. 10 or 12 drops, added to 1 fl. oz. of pure cold water, make a transparent camphor julep, as before. There is a large quantity of these solutions of camphor sold by the London houses, who charge a considerable price for them. They are very convenient for preparing extemporaneous camphor julep or camphor mixture in dispensing.

3. (*Fordred.*) Tincture of camphor, 13 fl. dr.; tincture of myrrh, $\frac{1}{2}$ fl. dr.; rectified spirit, $18\frac{1}{2}$ fl. dr.; mix. 1 fl. dr. added to 4 fl. oz. of water forms camphor julep. It has been proposed to bleach the tincture of myrrh with animal charcoal, but this interferes with its proper action.

4. (Homœopathic.) See CHOLERA REMEDIES, Nos. 6 and 7.

5. (*Houlton.*) Spirit of camphor (Ph. L.), 1 fl. oz.; proof spirit, 7 fl. oz. 1 fl. dr. to 3 fl. oz. of water forms 'CAMPHOR JULEP.'

6. (*Redwood.*) Camphor, 1 dr.; rectified spirit, $2\frac{1}{2}$ oz.; dissolve, and add of water, $\frac{1}{2}$ oz.

7. (*Swediaur.*) Powdered camphor, 1 dr.; water saturated with carbonic acid gas, 12 fl. oz.; dissolve. 1 part of this solution, added to 4 parts of water, forms 'CAMPHOR MIXTURE.' See CAMPHOR.

Essence of Cap'sicum. See ESSENCE OF CAYENNE.

Essence of Car'away. *Syn.* ESSENTIA CARUI, L. *Prep.* From oil of caraway, as ESSENCE OF ALMONDS. Its applications and uses are similar. An inferior kind is prepared by macerating the seeds in proof spirit.

Essence of Car'damoms. *Syn.* ESSENTIA CARDAMOMI, E. C. CONCENTRATA, L. *Prep.* From lesser cardamom seeds (ground in a pepper-mill), $5\frac{1}{2}$ lbs.; rectified spirit of wine, 1 gall.; digest for a fortnight, press, and filter.

Obs. This preparation is very convenient for flavouring cordials, pastry, &c., and is very powerful. In the laboratory it is frequently substituted for powdered cardamoms in making compound extract of colocynth, and has the advantage of adding no inert matter to the preparation, whilst it imparts the characteristic odour of the seeds in a remarkable degree. When used in this way it is not added to the extract until it is nearly cold and about to be taken from the pan. The testæ or shells of the seed should be separated from the kernels, as the former are quite inert, and if used occasion a loss of spirit for no purpose.

Essence of Cascaril'la. *Syn.* ESSENTIA CASCARILLÆ, L. *Prep.* 1. Cascarilla (bruised), 12 oz.; proof spirit, 1 pint; proceed either by digestion or percolation. The product is 8 times the strength of the infusion of cascarilla (Ph. L.).

2. See INFUSION (Concentrated).

Essence of Cas'sia. *Syn.* ESSENTIA CASSIÆ, L. *Prep.* From oil of cassia, as essence of allspice or almonds.

Essence of Cayenne. *Syn.* ESSENCE OF CAYENNE PEPPER, E. OF CAPSICUM, CONCENTRATED E. OF C.; ESSENTIA CAPSICI, TINCTURA CAPSICI CONCENTRATA, L. *Prep.* 1. Capsicum (recent dried pods, bruised), 3 lbs.; rectified spirit, 1 gall.; digest 14 days, press, and filter. Some persons prepare it by the method of displacement.

2. Capsicum, ¼ lb.; proof spirit, 1 pint; digest as before. Weaker than No. 1.

3. (*Kitchener's.*) Cayenne pepper, 1 oz.; brandy, 1 pint; digest, &c., as before.

Obs. The product of the first formula is a transparent, dark-coloured liquid, having an intensely burning taste. One drop is sufficient to deprive a person of the power of speech for several seconds; and a few drops will impart the rich pungency of cayenne to a large quantity of soup, sauce, or any other article. It forms the 'ESSENCE OF CAYENNE' and the 'CONC. ESS. OF CAYENNE PEPPER' of the London houses. It is principally used as a 'flavouring,' and to make SOLUBLE CAYENNE PEPPER; also in dispensing. It is fully 8 times as strong as the 'TINCTURA CAPSICI' (Ph. L.). The product of the third formula is used exclusively for culinary purposes. The pods or fruit of *Capsicum annuum* (capsicum chilly), *C. baccatum* (bird pepper), and *C. frutescens* (Guinea pods, red pepper) are indiscriminately used for this preparation, but the first are those preferred for medicinal purposes; the others have similar properties, but are more pungent and acrimonious; hence the preference given to them in the preparation of cayenne pepper. See PEPPER.

Essence of Ce'drat. See OIL (Volatile).

Essence of Ce'lery. *Syn.* ESSENCE OF CELERY SEED; ESSENTIA APII, ESS. A. SEMINIS, L. *Prep.* 1. From celery seed (bruised or ground), 4½ oz.; proof spirit, 1 pint; digest a fortnight, and strain.

2. (Concentrated.) Celery seed, 7 oz.; rectified spirit, 1 pint; digest as before. Very fine. Both are used for flavouring.

Essence, Cephalic. See ESSENCE FOR THE HEADACHE.

Essence of Cham'omile. *Syn.* CHAMOMILE DROPS; ESSENTIA ANTHEMIDIS, E. CHAMÆMELI, E. C. ALBA, L. *Prep.* 1. From essential oil of chamomile, as essence of allspice. Stomachic and stimulant.—*Dose,* 5 to 30 drops; ½ fl. oz., shaken with about 1 pint of pure water, forms an excellent extemporaneous chamomile water.

2. Gentian root (sliced or bruised), 1 lb.; dried orange peel, ¼ lb.; proof spirit, 1 gall.; essential oil of chamomile, 3½ fl. oz.; macerate a week. Slightly coloured. Some persons use ½ lb. of quassia wood instead of the gentian and orange peel. Both the above are stomachic and tonic, and are favourite remedies in loss of appetite, dyspepsia, &c.—*Dose.* As the last, on sugar, or in a wine-glassful of wine or beer.

Essence of Chiret'ta. See INFUSION (Concentrated).

Essence of Cin'namon. *Syn.* ESSENTIA CINNAMONI, SPIRITUS C. CONCENTRATUS, L. *Prep.* 1. From oil of cinnamon, as ESSENCE OF ALLSPICE or ALMONDS.

2. Cinnamon, 5 oz.; rectified spirit, ¾ pint; water, ¼ pint; digest a week and strain. Inferior to the last. Essence of cassia is commonly sold for it.

Essence of Civ'et. *Syn.* ESSENTIA ZIBETHI, L. *Prep.* 1. Civet (cut small), 1 oz.; rectified spirit, 1 pint; as ESSENCE OF MUSK.

2. Instead of rectified spirit use spirit of ambrette. Both are used in perfumery, chiefly in combination with other substances.

Essence of Cloves. *Syn.* ESSENTIA CARYOPHYLLI, L. *Prep.* 1. (White.) From oil of cloves, as ESSENCE OF ALLSPICE. Used as a 'flavouring.'

2. (Coloured.) Cloves (bruised), 3½ oz.; proof spirit, ¾ pint; water, ¼ pint; digest a week and strain. Inferior to the last. It is 8 times as strong as INFUSION OF CLOVES (Ph. L.). Chiefly used in dispensing.

Essence of Cof'fee. See COFFEE.

Essence of Cog'nac (kōne'-yăk). *Syn.* BRANDY ESSENCE. *Prep.* From brandy oil, 2 fl. oz.; rectified spirit, 18 fl. oz. For flavouring malt spirit to imitate brandy. See OIL.

Essence of Cologne. *Syn.* CONCENTRATED EAU DE COLOGNE; ESSENTIA COLONIENSIS, AQUA C. CONCENTRATA, L. *Prep.* 1. By taking 8 times the quantity of the ingredients ordered for COLOGNE WATER, and using the strongest refined spirit.

2. Oils of lemon and cedrat, of each, 2 dr.; oil of rosemary, 1 dr.; oil of bergamotte, 1 oz.; spirit of neroli, 2 fl. oz.; purest rectified spirit, 5 fl. oz. Used as a condensed perfume.

Essence of Colts'foot. *Prep.* 1. (*Ryan.*) Balsam of tolu, 1 oz.; rectified spirit and compound tincture of benzoin, of each, 3 oz.; dissolve, and in a few days decant the clear portion.

2. (*Paris.*) Equal parts of balsam of tolu and compound tincture of benzoin, with double the quantity of rectified spirit.

3. Tincture of tolu, 5 fl. oz.; compound tincture of benzoin, 3 fl. oz.; powdered sugar (quite dry), 1 oz.; hay saffron, 1 dr.; digest a week, with frequent agitation.

Obs. Pectoral and stimulant. A quack remedy for consumption and most other diseases of the lungs, but, unless assisted by occasional aperients, and in the absence of fever, it is more likely to kill than cure in these complaints. The last is the best formula.

Essence of Cu'bebs. *Syn.* CONCENTRATED ESSENCE OF CUBEBS; ESSENTIA CUBEBÆ, E. C. CONCENTRATA, L. *Prep.* 1. Cubebs (bruised, or preferably ground in a pepper-mill), ½ lb.; rectified spirit, 1 pint; digest 14 days, press, and filter.

2. (Wholesale.) Cubebs, 4¼ lbs.; rectified spirit, 1 gall. The essence has a very large sale, and if carefully prepared from a good sample of the drug is a most excellent preparation. Every fl. oz. represents 2½ dr. of cubebs.—*Dose,* 1 to 3 dr.

Essence of Cubebs (Oleo-resinous). *Prep.* (*Dublanc.*) Oleo-resinous extract of cubebs, 1 oz.; rectified spirit, 3 oz.; dissolve. A very active and concentrated form of administering cubebs, which must not be confounded with the preceding preparation, which is the one always meant when 'Essence of Cubebs' is ordered.—*Dose,* ½ dr. to 1 dr.

Essence of Dill. *Syn.* DILL DROPS; ESSENTIA ANETHI, L. *Prep.* 1. From oil of dill, as ESSENCE OF ALLSPICE.

2. Oil of dill, extract of dill, and salt of tartar, of each, ½ oz.; rectified spirit, 1 pint; digest and strain. Both the above are aromatic and antiflatulent. The first is commonly used as an adjunct to other medicines, especially to purgatives for children. The second is a popular tonic and stomachic in the flatulent colic, dyspepsia, &c., of women and children.—*Dose.* A few drops, on sugar.

Essence of Er'got. See LIQUOR OR ERGOT OF RYE.

Essence of Ergot (Ethereal). *Syn.* ESSENTIA ERGOTÆ ETHEREA, E. SECALIS CORNUTI E., L. *Prep.* 1. (*Mr Lever.*) Ergot (powdered), 2 oz.; rectified sulphuric ether, 2 fl. oz.; digest a week, express the tincture, filter, and abandon the liquid to spontaneous evaporation; lastly, dissolve the residuum in ether, 1 fl. oz. This is an expensive and troublesome formula. The following modification of it is both simpler and less expensive.

2. Ergot (ground), 8 oz.; ether, 16 fl. oz.; prepare a tincture as before, and by a gentle heat distil off the ether in a retort connected with a well-cooled refrigerator, until 15 fl. oz. shall have passed over; continue the evaporation at a reduced heat until the remainder of the ether has passed off; lastly, dissolve the residuum, as soon as cold, in ether, 4 fl. oz.

Obs. Each fl. oz. represents 2 oz. of ergot.—*Dose,* 10 to 30 drops as a parturifacient, taken on sugar; 3 to 5 drops as a hæmostatic and emmenagogue, in hæmorrhages, floodings, &c. It possesses all the acrid, narcotic principle of the ergot, but less of the hæmostatic principle than the ordinary essence, whilst it is much more costly.

Essence of Fen'nel. *Syn.* ESSENCE OF SWEET FENNEL; ESSENTIA FŒNICULI, L. *Prep.* From oil of fennel (*Fœniculum dulce*), as ESSENCE OF ALLSPICE.

Essence of Gen'tian. See INFUSION OF GENTIAN (Concentrated).

Essence of Gin'ger. *Syn.* CONCENTRATED TINCTURE OF GINGER; ESSENTIA ZINGIBERIS, TINCTURA Z. CONCENTRATA, L. *Prep.* 1. Unbleached Jamaica ginger (bruised), 5 oz.; rectified spirit, 1 pint; digest a fortnight, press, and filter.

2. (*Oxley's* 'CONCENTRATED ESSENCE OF JAMAICA GINGER.') The same as the preceding, with the addition of a very small quantity of essence of cayenne. The above possesses only about 4 times the strength of tincture of ginger (Ph. L.); and though vended in the shops as essence of ginger, scarcely deserves the name.

3. As No. 1 (next article, *below*), but using double the quantity of spirit. Very fine.

4. (*Kitchener's.*) Ginger (grated), 3 oz.; yellow peel of lemon (fresh), 2 oz.; brandy, 1½ pints; digest 10 days. For culinary purposes, &c. (see *below*).

Essence of Ginger (Concentrated). *Syn.* ESSENTIA ZINGIBERIS CONCENTRATA. *Prep.* 1. Jamaica ginger (best unbleached, in coarse powder) and siliceous sand, equal parts, are sprinkled with rectified spirit of wine, q. s. to perfectly moisten them, and after 24 hours the mass is placed in a 'percolator,' and after returning the first runnings 2 or 3 times, the receiver is changed, and more rectified spirit poured on gradually, and at intervals, as required, until as much essence is obtained as there has been ginger employed.

Obs. The quality of the product of the above formula is excellent, but the process is somewhat difficult to manage. The mass remaining in the percolator is treated with fresh spirit until exhausted, and the tincture so obtained is employed, instead of spirit, for making more essence with fresh ginger. The last portion of spirit in the waste mass may be obtained by adding a little water. Coarsely powdered charcoal is frequently used instead of sand, in which case the product has less colour; at the same time, however, a little of the flavour is lost.

2. (Wholesale.) *a.* Best unbleached Jamaica ginger (as last), 12 lbs.; rectified spirit, 2½ galls., are digested together for 14 days, and the expressed and strained tincture reduced by distillation, in a steam or water bath, to exactly 1 gall.; it is next cooled, and transferred as quickly as possible into stoppered bottles, and the next day filtered.

Obs. The product of the last formula is a most beautiful article, of immense strength and the richest flavour. When possible, hydraulic pressure should be employed to express the tincture. 2 oz. of this essence are regarded as equivalent to 3 oz. of the finest ginger, being fully 20 times as strong as the 'TINCTURE OF GINGER' (Ph. L.). "A single drop swallowed will almost produce suffocation" (*Cooley*).

b. From ginger (as last), 24 lbs.; rectified spirit, 6 galls.; make a tincture, as before, and reduce it by distillation to 1 gall.; then cool as quickly as possible out of contact with the air, and add, of the strongest rectified spirit of wine, 1 gall.; lastly, filter if required. Quality resembles No. 2, *a* (nearly). "We are in the habit of applying the method developed in the last two formulæ to the preparation of the essences of several other substances, the active principles of which are not volatile at a low temperature" (*Cooley*).

Essence of Grape. *Prep.* From grape oil, as ESSENCE OF ALMONDS. It is used to flavour brandy and wines. See OIL (Volatile).

Essence of Guai'acum. *Syn.* FLUID EXTRACT OF GUAIACUM; ESSENTIA GUAIACI, EXTRACTUM GUAIACI FLUIDUM, L. *Prep.* Recent guaiacum shavings, from which the dust has been sifted, 3 cwts., are exhausted by decoction in water, as in the preparation of an extract, using as little of that fluid as is absolutely necessary; the decoction is evaporated to exactly 1¾ galls.; it is next stirred until cold, to prevent the deposit of resinous matter, when it is put into a bottle, and spirit of wine, 5 pints, is added; the whole is then repeatedly agitated for a week, after which it is allowed to settle for 7 or 8 days, and the clear portion is decanted into another bottle.

Obs. This preparation is frequently substituted for guaiacum shavings in the preparation of compound decoction of sarsaparilla. 1 pint of this essence is considered equivalent to 19 lbs. of guaiacum in substance. See DECOCTION OF SARSAPARILLA (Comp.).

Essence for the Handkerchief. See ESSENTIA ODORATA, &c.

Essence for the Headache. *Syn.* Cephalic essence, Embrocation of ammonia, Dr Hawkins' embrocation, Ward's e., Ward's essence for the headache; Embrocatio ammoniæ, Linimentum a., Essentia cephalica, L. *Prep.* 1. Oil of lavender (Mitcham), 1 dr.; camphor, 1 oz.; liquor of ammonia, 4 oz.; rectified spirit, 1 pint; dissolve. Very fragrant and powerful.

2. (*Beasley.*) Spirit of camphor, 2 lbs.; strong water of ammonia, 4 oz.; essence of lemon, ½ oz.

3. (*Redwood.*) Camphor and liquor of ammonia, of each, 2 oz.; oil of lavender, 4 dr.; rectified spirit, 14 oz. Very fragrant. Stimulant and rubefacient. Used as a counter-irritant lotion in local pains, as headache, earache, colic, &c. Compound camphor liniment is usually sold for it. See Liniment.

Essence of Henbane. *Syn.* Essentia hyoscyami, L. See Essence (Anodyne), No. 2.

Essence of Hop. *Syn.* Essentia lupuli, E. humuli, Tinctura lupuli concentrata, L. *Prep.* 1. New hops (rubbed small), 26½ oz.; proof spirit, 1 quart; digest 24 hours, then distil over (quickly) 1 pint, and set the distillate (*spiritus lupuli*) aside in a corked bottle; to the residuum add water, 1 pint; boil 15 minutes, cool, express the liquor, strain, and evaporate it as quickly as possible to dryness by the heat of a water-bath, powder the residuum, and add it to the distilled spirit; digest a week and filter.

2. Lupulinic grains (yellow powder or lupulin of the strobiles), 5 oz.; rectified spirit, 1 pint; digest 10 days; express, and filter. Both the above are powerfully bitter, and loaded with the aroma of the hop. They are fully 8 times as strong as the 'tinctura lupuli' of the Ph. L. A few drops added to a glassful of ale or beer render it agreeably bitter and stomachic.

3. (Brewer's E. of Hops.) Several noxious preparations under the name of extract of hops are sold by the brewer's druggist. They are mostly semi-fluid extracts of quassia, gentian, and like powerful bitters. Of three of these articles which we have examined, one (for pale ale) consisted of the mixed extracts of quassia and chamomile; another was a preparation of picric acid; whilst a third ('strongly recommended for porter') consisted of about equal parts of the extracts of bitter aloes, cocculus indicus, and wormwood. A few years ago one of these vile compounds was publicly advertised, and 'warranted' as being equal to 100 times its weight in hops (1 oz. to 5½ lbs.).

Essence of Jargonelle Pear. *Syn.* Pear essence, Esprit de jargonelle, &c. *Prep.* From pear oil (acetate of oxide of amyl), as essence of almonds. This is now largely employed to flavour confectionery and liqueurs. See Amyl and Oil (Volatile).

Essence of Jas'mine. See Spirit and Oil (Volatile).

Essence of Jes'samine. See Spirit and Oil.

Essence of Jon'quil. See Spirit and Oil.

Essence of Krouen. *Syn.* Krouen essentz. Rad. angelicæ, 1500 grms.; rad. zedoariæ, 1500 grms.; rad. tormentillæ, 1000 grms.; rad. diptamine, 1000 grms.; herb. cardui. benedict., 3000 grms.; succus liquiritiæ, 6000 grms.; camphor, 500 to 1000 grms.; aloes, 6000 grms.; theriac. Venet., 1500 grms.; rad. gentianæ, 1000 grms.; agarica alba, 750 grms.; myrrh, 2000 grms.; spt. rectificat., 90%, 200 kilos. Digest for at least a fortnight. As regards the use of it, this essence is a universal remedy for everything. The essence is sent out with English descriptive matter, especially to India *viâ* Calcutta and Bombay, and I do not think it would be difficult to get a circular in the English language ('Chemist and Druggist').

Essence of Lav'ender. *Syn.* Essentia lavandulæ (odorata), L. *Prep.* 1. Oil of lavender (Mitcham), 2 oz.; rectified spirit (strongest), 1 pint.

2. As the strongest *Eau de lavende.* See Spirit.

Essence of Lavender (Red). See Spirit and Tincture.

Essence of Lem'on. *Syn.* Essentia limonis, L. *Prep.* 1. See Oil (Volatile).

2. (*W. Procter.*) Fresh oil of lemons, 1 fl. oz.; deodorised alcohol (strongest flavourless rectified), 8 fl. oz.; exterior yellow rind of lemons (fresh), ½ oz.; digest 48 hours, and filter. Used for flavouring mixtures, pastry, &c.

3. From oil of lemons, as essence of allspice. Used as the last.

Essence of Lemon Peel. *Syn.* Essence of lemon rind, Quintessence of l. p.; Essentia corticis limonis, L. *Prep.* 1. Yellow peel of fresh lemons, ½ lb.; spirit of wine, 1 pint; digest for a week, press, and filter. Very fragrant.

2. Yellow peel of fresh lemons, 1 lb.; boiling water, ½ gall.; infuse 1 hour, express the liquor, boil down to ½ pint, cool, and add oil of lemon, ¼ oz., dissolved in spirit of wine, 1½ pints; mix, and filter. Used as the preceding.

Essence of Lov'age. *Syn.* Essentia levistici, L. *Prep.* (Ph. Wurt.) Lovage root (*Levisticum officinale*), 2 oz.; lovage seeds, 1 oz.; rectified spirit, 10 oz.; digest a week, and filter. Aromatic, stomachic, and diaphoretic.—*Dose*, ½ dr. to 1 dr.; in dyspepsia, dropsies, &c.

Essence, Madden's. Concentrated infusion of roses.

Essence of Malt. See Colouring.

Essence of Mint. *Syn.* Essence of spearmint; Essentia menthæ, E. m. spicatæ, E. m. viridis, L. *Prep.* As essence of peppermint.

Essence of Moss Rose. (From the 'Chemist and Druggist.') Otto of roses, 1½ dr.; essence of ambergris, 2½ oz.; essence of musk, 1 oz.; alcohol, 15 oz.; concentrated rose-water, 10 oz. Mix, and shake frequently for a week.

Essence of Musk. *Syn.* Essentia moschi, Tinctura m. concentrata, L. *Prep.* 1. Grain musk, 2 oz., and boiling water, 1 pint, are digested together in a close vessel until cold, when rectified spirit of wine, 7 pints, is added; the vessel (preferably a tin bottle) being corked close and tied over with bladder, the whole is digested, with frequent agitation, for 2 months, in the sunshine (in summer), or in an equally warm situation in winter. At the end of the time the essence is decanted and filtered.

2. Grain musk, ¼ oz.; rectified spirit of wine, 2 pints; essence of ambergris, 1 fl. oz.; digest as before.

3. Musk (from the bladder, rubbed very small),

5 oz.; civet, 1 oz.; essence of ambergris, 1 pint; spirit of ambrette, 1 gall.; as before.

Obs. All the preceding formulæ yield superior essences, but the product of the last is of the very finest quality, and such as is seldom sold, except by the most celebrated houses, when it fetches a very high price. It is powerfully and deliciously odorous, and has received the approval of royalty itself, both in these kingdoms and on the Continent. The second formula also produces a very fine article, but less choice than just referred to. The digestion should be long continued, and on no account less than 3 weeks, as otherwise much fragrant matter is left undissolved. The addition of 1 fl. dr. of either liquor of ammonia or liquor of potassa (the first is best) to each pint of the essence vastly increases its fragrance. The essence of musk of the wholesale London druggists is generally made by merely digesting the freshly emptied musk-pods in rectified spirit. Sometimes a little (a very little) grain musk is added. See ESSENCE ROYALE and ESSENCE OF AMBERGRIS.

4. (*Guibourt.*) Musk, 1 part; proof spirit, 12 parts; digest a fortnight, or longer. Used in dispensing, &c.

Essence of Musk-seed. See ESSENCE D'AMBRETTE.

Essence of Mustard. *Syn.* ESSENTIA SINAPIS, L. *Prep.* (*Whitehead's.*) Black mustard-seed (bruised) and camphor, of each, 2 oz.; oil of rosemary, 3 dr.; balsam of tolu, 1 dr.; annatto, ½ dr.; digest a week, and filter.

Essence of Myr'tle. *Syn.* ESSENCE OF MYRTLE BLOSSOMS; ESSENCE DE MYRTE, ESPRIT DE M., Fr. *Prep.* Myrtle-tops (in blossom), 2½ lbs.; proof spirit, 9 pints; digest 3 days, then distil 1 gall. A pleasant perfume. See OIL (Volatile).

Essence of Nero'li. *Syn.* ESSENCE DE FLEURS D'ORANGES, ESPRIT DE F. D'O., Fr. *Prep.* 1. Neroli, 3 dr.; rectified spirit of wine, 1 pint; mix. A delicate perfume.

2. Oil of orange, 2 dr.; orris-root (bruised), ½ oz.; ambergris, 10 gr.; neroli, 35 drops; spirits of wine, 1 pint; digest 14 days, and filter. Very fragrant, but less 'chaste' than the last.

Essence of Nut'meg. *Syn.* ESSENTIA MYRISTICÆ, E. M. MOSCHATÆ, E. NUCIS M., L. *Prep.* From essential oil of nutmeg, as ESSENCE OF ALLSPICE. Used as a flavouring or zest by cooks, liqueuristes, and confectioners.

Essence, Odontalgic. See ESSENCE, TOOTHACHE.

Essence d'Œillets. [Fr.] *Prep.* From cinnamon, 3 oz.; cloves, 1¼ oz. (both well bruised); rectified spirit, 1 quart; digest for a week. Oil of cloves and spirit of cloves also bear this name in some places.

Essence of O'pium. See ESSENCE, ANODYNE, No. 1. BLACK DROP and ROUSSEAU'S LAUDANUM have also been sometimes so called.

Essence of O'range. *Syn.* ESSENTIA AURANTII, L. *Prep.* As ESSENCE OF LEMON.

Essence of Orange Peel. *Syn.* ESSENTIA CORTICIS AURANTII, L. *Prep.* 1. (Golden.) Fresh yellow rind of orange, 4 oz.; rectified spirit and water, of each, ½ pint; digest for a week, press, filter, and add of sherry wine, 1 quart. A pleasant liqueur.

2. (Saccharated.) See OLEO-SACCHARUM.

Essence of Patch'ouli. *Syn.* ESSENCE DE PATCHOULIE, ESPRIT DE POUCHÂ PÂT, Fr. *Prep.* 1. Indian patchouli (leaves or foliaceous tops), 2½ lbs.; rectified spirit, 9 pints; digest for a week; add of water, 1 gall.; oil of lavender (Mitcham), 3 dr.; common salt, 2 lbs.; agitate well together, distil over (rapidly) 1 gall., and add of essence of musk, 3½ fl. dr. A very fashionable perfume.

2. Patchouli, 3 oz.; rectified spirit, 1 pint; digest a week, press, and filter. A still commoner kind is made with proof spirit.

Essence of Pear. See ESSENCE OF JARGONELLE.

Essence of Pen'nyroyal. See ESSENTIA PULEGII, E. MENTHÆ P., L. *Prep.* From pennyroyal (*Mentha pulegium*), as ESSENCE OF PEPPERMINT. Stimulant, carminative, and emmenagogue. Used in dispensing, especially to make extemporaneous pennyroyal water.

Essence of Pep'permint. *Syn.* ESSENTIA MENTHÆ PIPERITÆ (B. P.), L. *Prep.* 1. (B. P.) Oil of peppermint, 1 part; rectified spirit, 4 parts. Mix.—*Dose*, 10 to 20 minims.

2. To the last add of herb peppermint, parsley leaves, or spinach leaves (preferably one of the first two), ½ oz., and digest for a week, or until sufficiently coloured. Sap green (10 or 12 gr., rubbed up with a teaspoonful of hot water) is also used for the same purpose. A delicate light green.

3. (Ph. U. S.) Oil of peppermint, 2 fl. oz.; rectified spirit, 16 fl. oz.

Obs. Essence of peppermint is not conceived to be good by the ignorant unless it has a pale-greenish tint, which they take as a proof of its being genuine. The most harmless way of tingeing it is that indicated above. A little green mint or parsley will, indeed, be found to improve the flavour. These additions are quite harmless. The practice of using cupreous salts, adopted by some unprincipled makers, is unpardonable, and admits of no excuse, as not the least advantage, either of convenience, cost, or appearance, results from such a practice, while the colouring matter, though small in quantity, is nevertheless sufficient to impart a noxious quality to the liquid. This fraud may be detected by the addition of liquor of ammonia in excess, which will strike a bluish or greenish-blue colour when copper is present.

Essence of peppermint (like that of most of the other aromatic oils) is cordial, stimulant, and stomachic. A few drops (10 to 30) on sugar, or mixed with a little water or wine, is an excellent remedy in flatulence, colic, nausea, sickness, &c. It is also extensively used as a flavouring ingredient by cooks, confectioners, and druggists. A few drops, well agitated with ½ pint of cold water, form an excellent extemporaneous peppermint water.

The formulæ 1 and 2, generally the latter, are those employed by the respectable portion of the London trade. The various published receipts for this and similar essences, ordering the essential oil in a larger proportion than that directed above, are never adopted in practice, and their products (often impossible combinations) exist only in the imaginations of the writers.

Essence of Pimen'to. See ESSENCE OF ALLSPICE.

Essence of Pine-apple. From pine-apple oil (butyric ether, butyrate of ethyl), as ESSENCE OF ALMONDS. It forms a delicious flavouring for liqueurs, confectionery, rum, &c. See ETHER and OIL (Volatile).

Essence of Quas'sia. *Syn.* ESSENTIA QUASSIÆ, L. *Prep.* 1. From quassia (sliced), 1½ oz.; proof spirit, 1 pint; digest 10 days and filter; ½ fl. dr. added to 7½ fl. dr. of water forms the infusion of quassia of the Ph. L.—*Dose*, ½ dr. in water or wine, an hour before a meal, as a stomachic tonic in dyspepsia, loss of appetite, &c., particularly when complicated with gout; 1 to 2 dr., 3 or 4 times daily, as a febrifuge and antiseptic, in intermittents, putrid fevers, &c.

2. (Brewer's.) *a.* From powdered quassia (sprinkled with a little rum) and 'foots' (coarse moist sugar or sugar bottoms), equal parts, reduced to the consistence of a semi-fluid extract by the addition of a few spoonfuls of water. For ale.

b. From powdered quassia, 1 part; burnt sugar colouring, 2 parts; well stirred together. For porter and stout. Both are used by fraudulent brewers as substitutes for hops.

Essence of Quin'ine. *Syn.* ESSENTIA QUINÆ, L. *Prep.* From disulphate of quinine, 1½ oz.; rectified spirit, ½ pint; digest with warmth, gradually dropping in a little dilute sulphuric acid (avoiding excess), and employing constant agitation until the whole is dissolved. 1 fl. dr., added to 7 dr. of proof spirit, forms the 'TINCTURE OF QUININE' (Ph. L.). Every fl. dr. contains 8 gr. disulphate of quinine, or about 10 gr. of the neutral sulphate. If more sulphuric acid is added than is sufficient to dissolve the salt (*i. e.* convert it into a neutral sulphate), the solution is apt to deposit part of it on keeping, owing to the gradual formation of ether by the action of the excess of acid on the alcohol.

Essence of Rat'afia. The same as Essence of Almonds. So called from being used to flavour ratafias, noyeau, and other liqueurs.

Essence of Rennet. See RENNET.

Essence of Rhu'barb. *Syn.* ESSENTIA RHEI, L. *Prep.* From rhubarb (in powder) and siliceous sand, of each, 5 oz.; proof spirit, 1 pint; by the method of displacement. Every fl. oz. represents the active virtues of 2 dr. of rhubarb.

Essence of Rondele'tia. *Prep.* 1. Essence (oil) of bergamotte, essence (oil) of lemon, and oil of cloves, of each, 1 dr.; otto of roses, 10 drops; rectified spirit, 1 pint.

2. To the last add of oil of lavender, 1 dr.; neroli, 15 drops. A very fashionable and agreeable perfume.

Essence of Rose'mary. *Syn.* ESSENTIA ROSMARINI, L. *Prep.* From oil of rosemary, as ESSENCE OF ALLSPICE. Used as a perfume; also to make extemporaneous rosemary water.

Essence of Ro'ses. *Syn.* ESSENTIA ROSÆ (ODORATA), L. *Prep.* 1. Attar of roses (genuine), 2 dr.; alcohol, 1 pint; agitate frequently until they unite.

2. Attar of roses, 1 oz.; rectified spirit, 1 gall.; mix in a close vessel, and assist the solution by placing it in a bath of hot water. (See ESSENCE OF MUSK.) As soon as the spirit gets warm, take it from the water and shake it till quite cold; the next day filter.—*Obs.* Unless the spirit of wine is of more than the common strength, it will not retain the whole of the otto in solution in very cold weather.

3. To each pint of either of the preceding, add of oil of bergamotte, 30 drops; neroli and essence of musk, of each, 20 drops.

4. Petals of roses, 3 lbs., digest in spirit of wine, 5 quarts, for 24 hours; distil to dryness in a water-bath; digest the distilled spirit on 2 lbs. of fresh rose-petals, as before, and repeat the whole process of maceration and distillation a 3rd, 4th, 5th, and 6th time, or oftener, the last time only drawing over 1 gall., which is the essence. Each of the above is very superior. The last has a peculiar delicacy of flavour when the spirit used to make it is pure.

Essence of Roses (Red). *Syn.* ESSENTIA ROSÆ (RUBRA), TINCTURA R. CONCENTRATA, L. *Prep.* From rose-leaves, 1 lb.; proof spirit, 1 gall.; digest for 14 days, press, strain, add concentrated acetic acid, 2½ fl. dr.; mix well, and the next day filter. Used to make extemporaneous SYRUP and HONEY OF ROSES, &c. Smells, colours, and tastes strongly of the flower. CONCENTRATED INFUSION OF ROSES is sold under the same name.

Essence Royale. [Fr.] *Prep.* 1. (*Soubeiran.*) Ambergris, 40 gr.; musk, 20 gr.; civet and carbonate of potassa, of each, 10 gr.; oil of cinnamon, 6 drops; oil of rhodium and otto of roses, of each, 4 drops; rectified spirit of wine, 4 fl. oz. (say ¼ pint); macerate for 10 days or longer. Antispasmodic and aphrodisiac. A few drops on sugar, or in syrup of capillaire.

2. See ESSENCE OF AMBERGRIS.

Essence of Sarsaparil'la. *Syn.* CONCENTRATED ESSENCE OF SARSAPARILLA; ESSENTIA SARZÆ, E. SARSAPARILLÆ, L. *Prep.* 1. Sarsaparilla root (best red Jamaica), 2¾ lbs., is carefully decorticated, the bark reduced to coarse powder, and digested for a week or 10 days in sherry, ¾ pint, and rectified spirit, ¼ pint, with frequent agitation; after which the essence is expressed, and in a week the clear portion is decanted from the sediment. A very elegant preparation. ½ fl. dr. added to 7 fl. dr. of water forms 1 fl. oz. of a solution of equal strength to decoction of sarsaparilla of the Ph. L. Every fl. oz. represents the active principles of 2 oz. (=2 oz. 85 gr. avoir.) of sarsaparilla root. In other words, it is twice as strong as the root, and 16 times as strong as the decoction.

2. Alcoholic extract of sarsaparilla, 7 oz.; sherry, ¾ pint; rectified spirit, ¼ pint; dissolve and filter. Strength as the last.

3. (*Beral.*) Alcoholic extract, 4 oz.; sherry wine, 1 pint; dissolve and filter. About 3 fl. dr., added to water, 1 pint, form an extemporaneous decoction.

4. (*Guibourt.*) Alcoholic extract, 4 oz.; white wine, 1 lb. Strength the same as Nos. 1 and 2 (nearly).

5. (*Hening.*) Sarsaparilla (bruised), 10 oz.; distilled water, 6 pints; macerate at a temperature of 120° F. for 6 hours and strain; repeat with the same quantity of fresh water; mix the liquors, and evaporate in china vessels at 160° F. If re-

duced to 10 fl. oz. (or to 9 fl. oz., with 1 fl. oz. of rectified spirit added), 1 fl. dr., mixed with 7 fl. dr. of water, will be equal to the decoction of the usual strength. If reduced to 5 fl. oz., 1 fl. dr. will be equal to 2 fl. oz. of the decoction.

6. The bark separated from sarsaparilla root, $2\frac{3}{4}$ lbs., is exhausted with water as last; the liquid is evaporated as quickly as possible, in a water-bath, to 16 fl. oz., and when cold, mixed with rectified spirit, 4 fl. oz. Strength same as No. 1.

7. The infusion in No. 6 is evaporated to $10\frac{1}{2}$ fl. oz., and when cold mixed with sherry, $\frac{1}{2}$ pint; in a week the clear portion is decanted from the sediment. Strength same as No. 1.

Obs. The formulæ Nos. 1, 2, 6, and 7 have each in turn been extensively employed by us in the laboratory with the most satisfactory results. See LIQUOR OF SARSAPARILLA.

Essence of Sarsaparilla (Compound). *Syn.* ESSENTIA SARSAPARILLÆ COMPOSITA, E. SARZÆ C., L. *Prep.* 1. 1 pint of Nos. 1, 2, 6, or 7 (*above*), is triturated with the extract prepared from mezereon bark, $3\frac{1}{4}$ oz., and extract of liquorice, 4 oz.; when mixed it is returned to the bottle, and essence of guaiacum, $1\frac{1}{2}$ fl. dr., and oil of sassafras, 20 drops, are added; the whole is then well agitated for at least 15 minutes, and after a week's repose the clear portion is decanted as before. $\frac{1}{2}$ fl. dr., with $7\frac{1}{2}$ fl. dr. of water, forms extemporaneous compound decoction of sarsaparilla.

2. (*Cadet.*) Sarsaparilla (bruised), 8 oz.; hot water, q. s.; exhaust the root by successive macerations; unite the liquors, and evaporate to 10 fl. oz.; strain, and add, when cold, of alcohol (·842) and tinctures of guaiacum and mezereon, of each, 4 fl. dr.; white wine, 1 fl. oz.; oil of sassafras, 12 drops; extract of liquorice, 2 dr.; agitate, and after repose decant as before. This is nearly 8 times as strong as 'DEC. SARZÆ CO.,' Ph. L. The first is the best formula. See LIQUOR OF SARSAPARILLA (Compound).

Essence of Sa″voury Spices. *Prep.* 1. Black pepper, 4 oz.; powdered turmeric, 3 dr.; coriander seeds, $1\frac{1}{2}$ dr. (all ground and genuine); oil of pimento, $1\frac{1}{2}$ fl. dr.; oils of nutmeg, cloves, cassia, and caraway, of each, $\frac{1}{2}$ dr.; rectified spirit, 1 pint; digest, with agitation, for a fortnight. Very fine.

2. Black pepper, 3 oz.; allspice, $1\frac{1}{4}$ oz.; nutmegs and burnt sugar, of each, $\frac{1}{2}$ oz.; cloves, cassia, coriander, and caraway seeds, of each, 1 dr. (all bruised or ground); rectified spirit, 1 pint; digest with agitation, as before, for 14 days, press, and filter. Used as a flavouring. When made with proof spirit or brandy, and only $\frac{1}{2}$ the above weight of spice, it is called 'TINCTURE OF SAVOURY SPICES.'

Essence of Sen′na. See LIQUOR and INFUSION (Concentrated).

Essence of Smoke. See ESSENCE, WESTPHALIAN.

Essence of Soap. *Syn.* SPIRIT OF SOAP, SHAVING FLUID; ESPRIT DE SAVON, ESSENCE DE SAVON, ESSENCE ROYALE POUR FAIRE LA BARBE, Fr.; ESSENTIA SAPONIS, TINCTURA SAPONIS CONCENTRATA, L. *Prep.* 1. Castile soap (in shavings), 4 oz.; proof spirit, 1 pint; dissolve, and add a little perfume.

2. Venetian soap, $\frac{3}{4}$ lb.; salt of tartar, 1 oz.; benzoin, $\frac{1}{2}$ oz.; spirit of wine, 1 gall.

3. Best soft soap, $\frac{1}{4}$ lb.; boiling water, 1 pint; dissolve, cool, and add oils of cinnamon (cassia), verbena, and neroli, of each, 6 drops; dissolved in rectified spirit, 1 pint; mix well, and if not perfectly transparent, add a little more strong spirit, or filter through blotting-paper.

Obs. This alcoholic solution of soap is chiefly used for shaving, and is very convenient in travelling, as a good lather may be instantly produced without the trouble of employing a soap-box. Instead of the above perfumes, 15 drops of essence of musk or ambergris, or 30 drops of any of the perfumed spirits, or 3 drops of attar of roses, or 6 drops of any of the aromatic essential oils, may be added, when a corresponding name is given to the preparation, as *esprit de savon, de la rose,* &c.

4. (P. Cod.) White soap, 3 oz.; carbonate of potassa, 1 dr.; proof spirit, 12 oz.; dissolve. Used medicinally. They are all used as frictions, &c.

5. (CAMPHORATED, *Guibourt.*) White soap, 3 parts; camphor, 1 part; spirit of rosemary, 16 parts; dissolve. A variety of opodeldoc. Used as an embrocation in rheumatic pains, sore throat, &c.

Essence of Soup Herbs. *Syn.* SPIRIT OF SOUP HERBS, CONC. TINCTURE OF S. H., &c. *Prep.* (*Kitchener's.*) Lemon thyme, winter savory, sweet marjoram, and sweet basil, of each, 1 oz.; lemon peel (grated) and eschalots, of each, $\frac{1}{2}$ oz.; bruised celery seed, $\frac{1}{4}$ oz.; proof spirit or brandy, 1 pint; digest for 10 days or a fortnight. A superior flavouring essence for soups, gravies, &c. See ESSENCE OF SAVOURY SPICES.

Essence of Spearmint. See ESSENCE OF MINT.

Essence of Sprats. *Syn.* ESSENCE OF BRITISH ANCHOVIES. From pickled sprats (British anchovies), as ESSENCE OF ANCHOVIES, for which it is commonly sold.

Essence of Spruce. *Syn.* FLUID EXTRACT OF SPRUCE; ESSENTIA ABIETIS, EXTRACTUM A. FLUIDUM, L. *Prep.* A decoction of the young tops of the black spruce-fir (*Abies nigra*), evaporated to the consistence of a thick syrup. Used to make spruce-beer, &c.

Essence, Toothache. *Syn.* ESSENTIA ODONTALGIA, L. *Prep.* 1. Acetate of morphia, $\frac{1}{2}$ dr.; tincture of pellitory of Spain (made with rectified spirit), 2 fl. oz.; acetic acid (glacial), 4 fl. dr.; dissolve, and add of oil of cloves, 6 fl. dr.

2. (*Redwood.*) Pellitory, $\frac{1}{2}$ lb.; extract of belladonna, 2 dr.; rectified spirit, 1 pint; digest 14 days, strain, and add, of hyponitrous ether, 1 oz.; oil of wine, $\frac{1}{2}$ oz.; oil of cloves, 2 dr. See DROPS (Odontalgic).

Essence of Tu″berose. *Prep.* The flowers are stratified with sheep's or cotton-wool, impregnated with the purest oil of ben or of olives, in an earthen vessel, closely covered, and kept for 12 hours in a water-bath; the flowers are then removed, and fresh ones substituted, and this is repeated until the oil (HUILE AU TUBEROSE) is sufficiently scented. The wool or cotton is then mixed with the purest spirit of wine, and distilled in a water-bath; or it is first digested in a warm situation and in a well-closed vessel for several days, during the whole of which time frequent agitation is had recourse to. A similar plan is

followed for the preparation of essences of jasmine, violets, and other like flowers. See SPIRIT.

Essence of Turtle. *Syn.* ESSENCE OF GREEN TURTLE. *Prep.* From essence of anchovies and shallot wine, of each, 3 oz.; basil wine, ½ pint; mushroom ketchup, ¼ pint; the juice of 2 lemons; the yellow peel of 1 lemon; curry powder, ¼ oz.; digest for a week. Used to impart the flavour of turtle to soups and gravies.

Essence of Tyre. See HAIR DYE.

Essence of Vanilla. *Syn.* ESSENTIA VANILLÆ, TINCTURA V. CONCENTRATA, L. *Prep.* 1. Vanilla (cut small), 2 oz.; rectified spirit, 1 pint; digest a fortnight.

2. (Wholesale.) Vanilla, 2 lbs.; rectified spirit, 1 gall.; proceed as for ESSENCE OF MUSK. Very superior.

3. Vanilla (best), ¾ lb.; spirit of ambrette, 1 quart; cloves, 30 gr.; grain musk, 7 gr.; as last. Much esteemed. It is chiefly used as a perfume and for flavouring.

Essence of Verbena. *Syn.* ESSENCE OF LEMON-GRASS, E. OF CITRONELLE; ESSENTIA VERBENÆ, L. *Prep.* 1. From oil of lemon-grass or verbena (*Andropogon citratum*), as ESSENCE OF ALLSPICE.

2. To the last add of essence of ambergris and bergamotte (oil), of each, 1 fl. dr.; neroli, ½ fl. dr.

3. To No. 1 add, of oils of lavender and bergamotte, of each, ½ dr.; essence of vanilla, 2 fl. dr. A powerful and refreshing perfume.

Essence of Violet. *Syn.* ESSENTIA VIOLÆ, L.; ESSENCE DES VIOLETTES, Fr. See ESSENCE OF TUBEROSE and SPIRIT.

Essence of Vittie Vayr. *Syn.* ESSENCE OF VETIVER; ESSENCE DE VITTIE VAYR DOUBLE, Fr. *Prep.* 1. Vittie vayr or cuscus (the root of *Andropogon muricatus*, cut small and bruised), 3 lbs.; proof spirit, 9 pints; digest a week, add of water, 5 pints, and the next day distil over 1 gall. of essence.

2. To the last, before distillation, add of otto of roses, ½ dr.; eau de melisse (spirit of balm), ½ pint; and proceed as before. Used as a perfume. In 1831 it was much employed in Paris as a prophylactic against cholera.

Essence, Volatile (Acetic). *Syn.* PUNGENT ACETIC ESSENCE; ESSENTIA VOLATILIS ACETICA, L. Aromatic vinegar.

Essence, Volatile (Ammoniacal). *Syn.* PUNGENT AMMONIACAL ESSENCE, AROMATIC AMMONIACAL E.; ESSENTIA VOLATILIS, E. V. AMMONICALIS, E. V. AROMATICA, &c., L. *Prep.* 1. Oil of cinnamon, 6 drops; otto of roses, 12 drops; oil of cloves, 1 fl. dr.; essence of bergamotte, 2 fl. dr.; oil of lavender (Mitcham), 4 fl. dr.; essence of musk, 5 fl. dr.; liquor of ammonia (strongest), 1 pint; mix in a cold place, and shake the bottle until the whole is combined.

2. Essence of violets and oil of cinnamon, of each, 12 drops; neroli, essence of jasmine, and otto of roses, of each, ½ dr.; oil of lavender, 1 dr.; essence royale and essence (oil) of bergamotte, of each, 2½ dr.; liquor of ammonia (strongest), 1 pint; as the last.

3. Oils of lemon and bergamotte, of each, 5 fl. dr.; oil of lavender, 1½ fl. dr.; otto of roses, 1 fl. dr.; oils of cassia, neroli, cloves, and cedrat, of each, ½ fl. dr.; oil of sandal-wood, 15 drops; liquor of ammonia (strongest), 1 pint.

4. Essence of bergamotte, 6 fl. dr.; oil of lavender, 4 fl. dr.; oil of cloves, 3 fl. dr.; oil of cassia, 1½ fl. dr.; oil of verbena (lemon-grass), 1 fl. dr.; otto of roses, 30 drops; liquor of ammonia, 18 fl. oz.

5. (*Redwood.*) Oil of bergamotte, 3 oz.; essence of lemons, 2 oz.; oil of lavender, 6 dr.; essence of jasmine, 4 dr.; oil of sassafras, 3 dr.; oil of neroli, 2 dr.; otto of roses, 1½ dr.; oil of origanum and essence of ambergris, of each, 1 dr.; musk, 20 gr.; macerate for a week, and decant the clear portion. It is added to the strongest liquor of ammonia in proportion of 1½ oz. to the pint.

Obs. The above are used to fill smelling-bottles. They are all very fragrant and refreshing.

Essence, Ward's. See ESSENCE, HEADACHE.

Essence, Westphalian. *Syn.* ESSENCE OF SMOKE, E. OF WOOD-SMOKE, CAMBRIAN ESSENCE, SMOKING FLUID; ESSENTIA FULIGINIS, &c., L. *Prep.* 1. Crude or empyreumatic pyroligneous acid, 1 pint; sugar colouring, 2 oz.; dissolve, and in a week decant the clear portion.

2. Tar, 3 dr.; sugar colouring, 2 oz.; hot crude pyroligneous acid, 1 pint; agitate constantly for 1 hour, and after repose decant the clear portion.

3. Acetic acid (Ph. L.), 1 pint; creosote, 5 dr.; mix. White.

4. Barbadoes tar, ¼ oz.; burnt sugar and common salt, of each, 1 oz.; strong pickling vinegar, ¾ pint; port or elder wine, ¼ pint; digest as before. Inferior to the preceding. Used to impart a smoky flavour to meat, fish, &c., by brushing it over them, or adding a little to the brine in which they are pickled.

Essence of Worm'wood. *Syn.* ESSENTIA AMARA, E. ABSINTHII, L. *Prep.* 1. Extract of wormwood, 4 oz.; oil of wormwood, 1 oz.; rectified spirit, 1 pint; digest a week and filter. Tonic, stomachic, and vermifuge.—*Dose*, 10 drops to a teaspoonful.

2. (*Van Mons.*) Tincture of wormwood, 1 pint; salt of wormwood, 5 dr.; extract of wormwood, 1 dr.; digest as before.—*Dose*, ½ to 1½ fl. dr.

ESSENCES, Fla''vouring. *Syn.* CULINARY ESSENCES, SPICE E., ESSENCES FOR THE TABLE, &c. Those used by cooks, confectioners, liqueurists, &c., are all made by either dissolving 1 fl. oz. of the essential oil of the particular substance in 1 pint of rectified spirit, or by digesting 4 to 6 oz. of the bruised spice, or 5 to 10 oz. of the dried herb in a like quantity (1 pint) of spirit. The first method is preferable, from being the least troublesome, and yielding the finest product. They are commonly labelled 'CONCENTRATED ESSENCE OF ——.' An inferior article, vended under the names of 'ESSENCES OF CULINARY HERBS,' 'CULINARY TINCTURES,' 'TINCTURES FOR KITCHEN USE,' &c., are prepared from half the above quantity of oil or spice, infused in a pint of proof spirit or British brandy. The principal compounds of this class are the essences of allspice, caraway, cardamoms, cassia, cayenne, celery seed, cinnamon, cloves, coriander seed, fennel, garlic, ginger, lemon peel, mace, marjoram, nutmegs, orange peel, peppermint, spearmint, sweet

basil, and the like. The whole of these are employed to flavour soups, gravies, sweetmeats, pastry, wines, mulled wines, liqueurs, &c.

Essences, Flower. Those for which separate formulæ are not given in this work may most of them be made from the essential oil of the flowers and rectified spirit, as the last; or by digesting the flowers (crushed or bruised), 3 to 5 lbs., in proof spirit, 2 galls., for a few days, and then drawing over, by distillation, 1 gall. For the essences of those flowers which are not strongly odorous, the spirit thus obtained is distilled from a like quantity of flowers, a second and a third time, or even oftener. The essences of other organic substances, whose fragrant principles are volatile, may be prepared in the same manner. A small quantity of some other odorous essence is frequently added to the product, to enrich or modify the fragrance. See FLOWERS and ESSENCES BY INFUSION.

Essences, Fra'grant. See FLOWER ESSENCES (*above*), ESSENTIA ODORATA, PERFUMERY, &c.

Essences, Fruit. See ESSENCES OF APPLE, PINE-APPLE, JARGONELLE, &c.

Essences by Infu'sion. This term, among perfumers, is commonly applied to those essences, *eaux*, and *esprits*, which are prepared by digesting the ingredients in the spirit used as the vehicle for the aroma, in opposition to those obtained by 'distillation,' or by 'contact' or 'pressure.' Thus, the ESSENCES OF AMBERGRIS, MUSK, and VANILLA are of this class.

Essences, Vi'nous. *Syn.* ESSENTIA VINOSA, L. These are prepared in a similar way to the wines (VINA) of the pharmacopœia, by using 8 times the usual quantity of ingredients, and the very strongest sherry wine. 1 fl. dr., added to 7 fl. dr. of wine or water (properly the first only), forms an extemporaneous imitation of the officinal VINA MEDICATA. Some of the above are largely used in dispensing, and by travellers. See LIQUOR and WINE.

ESSENTIA BI'NA. See COLOURING.

Essentia Odora'ta. *Prep.* 1. Oil of lavender, 1 dr.; oils of cloves, cassia, and bergamotte, of each, ½ dr.; neroli, 20 drops; essence royale, 2 fl. dr.; rectified spirit, ½ pint; mix.

2. (*Redwood.*) English oil of lavender, 48 drops; oil of cloves, 32 drops; oil of orange peel, 16 drops; oil of bergamotte and sweet spirit of nitre, of each, 8 drops; oil of yellow sandal-wood, neroli, and otto of roses, of each, 2 drops; oil of cinnamon, 1 drop; rectified spirit, and essence of ambergris and musk, of each, 1 oz.; honey water, 8 oz.; mix. Used as a perfume for the handkerchief, &c. The last form seems unnecessarily complicated and minute.

Essentia Odorif'era. *Prep.* 1. Grain musk and balsam of Peru, of each, 10 gr.; civet, 4 gr.; oil of cloves, 5 drops; oil of rhodium, 3 drops; salt of tartar (dried by a dull-red heat and cooled), ½ dr.; rectified spirit (strongest), 2½ fl. oz.; macerate for 14 days, and pour off the clear.

2. Oil of rhodium and balsam of Peru, of each, ½ dr.; oil of cloves, 1 dr.; spirit of ammonia, 2 fl. dr.; essence of civet and vanilla, of each, 2 fl. oz.; essence of musk, 5 fl. oz.; neroli, oils of lavender, verbena, and cassia, of each, 6 drops. As the last. Both are very pleasant, durable, and powerful perfumes for personal use.

ESSENTIAL OIL. See OIL (Volatile).

ESSENTIAL SALT OF BARK. See BARK and EXTRACT.

ESSENTIAL SALT OF LEMONS. *Syn.* SALT OF LEMONS; SAL LIMONUM, L. The preparation sold under this name is made by mixing cream of tartar (bitartrate of potassa) with twice its weight of salt of sorrel (quadroxalate of potassa), both in fine powder. It is used to remove ink, fruit stains, &c., from linen, by rubbing a little of it on the part moistened with warm water. It is poisonous if swallowed in quantity.

ETCH'ING. A species of engraving, in which the design is formed on the plate by the action of an acid, or some other fluid, instead of being cut out by the graver.

Proc. In the ORDINARY PROCESS OF ETCHING the plate is covered with 'etching ground' (an acid-resisting varnish), and the design is scratched on the metal through the ground, by means of a pointed tool of steel called the 'etching needle' or 'point.' A border of wax is then placed round the plate, and the 'biting' fluid poured on, and allowed to remain till the 'lights' or finest portions of the design are sufficiently 'bitten in.' The etching fluid is then poured off, the plate washed, and the light parts 'stopped out' with Brunswick black or other varnish; the solvent is again poured on and allowed to remain until the finest portion of the exposed lines are sufficiently deep, when the acid is again poured off, and the whole process is repeated till the very darkest lines or shadows are sufficiently 'bitten in.' The plate is then cleaned, and is ready to be printed from. Occasionally the etched design receives a few finishing touches with the 'graver.'

There are several varieties of etching, of which the following are the principal:—ETCHING WITH A SOFT GROUND, when a coating of lard or tallow is employed, and the design is drawn on a piece of paper, laid evenly on the ground, by which means the fatty matter adheres to the paper, on the parts pressed on by the point or pencil, and the copper beneath becomes exposed, and is then acted on by the acid. The effect resembles that of chalk or pencil drawings.—STIPPLING, or executing the design in dots instead of lines.—AQUATINTA OR AQUATINT, a mode of etching on copper for producing an effect resembling a drawing in Indian ink. It is performed by sifting powdered asphaltum or lac-resin on the plate, previously slightly greased, and, after shaking off the loose powder, gently heating it over a chafing dish; on cooling, the lights are covered with turpentine varnish coloured with lamp-black, by means of a hair pencil, and a rim of wax being placed round the plate, a mixture of 'aquafortis' and water is poured on it, and allowed to remain for 5 or 6 minutes, when it is poured off, the plate dried, and recourse had to the pencil as before. The process of 'stopping' and etching' is repeated again and again, until the darkest shades are produced. Sometimes, instead of using asphaltum, an alcoholic solution of shell-lac or gum-mastic is poured over the plate, placed in a slanting direction; this varnish forms a film, which on drying leaves innumerable

cracks or minute fissures through which the acid acts on the plate. The fineness or coarseness of the grain depends entirely upon the condition of the powdered asphaltum, or on the quantity of matter dissolved in the spirit employed to form the ground.

The fluids employed for 'biting in' the designs vary considerably, almost every artist having his own receipt. Aquafortis, more or less diluted, is, however, generally employed for COPPER, and this, with the addition of pyroligneous acid, for etching on STEEL; but any fluid that rapidly dissolves the metal may be used for the purpose. The 'etching ground' may be formed of any substance capable of resisting the action of the etching fluid, and which is, at the same time, sufficiently soft to allow of the free use of the needle or point, and sufficiently solid to prevent an injury to the design during the 'scratching in.'

In ETCHING ON GLASS, the ground is laid on, and the design 'scratched in' in the usual way, when liquid hydrofluoric acid is applied, or the glass is exposed to the action of hydrofluoric acid gas. The former renders the surface of the etching transparent, the latter opaque. A simple modification of the process is to wet the design with sulphuric acid, and then to sprinkle on some finely pulverised fluor-spar (fluoride of calcium), by which means hydrofluoric acid is set free and attacks the glass. This method may be very easily applied to the graduation of glass vessels, thermometer tubes, &c.

ETCHING ON GLASS BY ELECTRICITY. (*Planté*, 'Ann Chem. Phys.' [5], xiii, 143–144.) The author had previously drawn attention to the fact that when an electric current is passed through saline solutions in glass vessels, platinum wire serving as electrodes, the glass is immediately attacked, and he therefore proposes the following method for etching on glass:

The surface of the glass to be engraved is coated with a concentrated solution of potassium nitrate, and beneath the layer of liquid a platinum wire connected with one of the poles of a battery is stretched across the plate. With the other pole is connected another platinum wire, the whole of which, except the point, is insulated; with this the designs are drawn on the glass, which is engraved wherever the wire comes in contact with it, flashes of light being emitted at the same time.

The depth of engraving depends on the rate at which the platinum wire moves; the slower the rate the deeper the line.

A RAPID METHOD OF ETCHING ON IRON OR STEEL, capable of very general application, is as follows:—"The metal is warmed until it is capable of melting a piece of beeswax, or 'etching ground,' which is then carefully rubbed over it, so as to form a thin and even coating; when cold, the design is 'scratched in' in the common way; a little powdered iodine is then sprinkled on the exposed parts, and at the same time a few drops of water are added, and the two worked into a liquid paste with a camel-hair pencil. The paste is then moved about over the intended etching, for a period varying from 1 to 5 minutes, according to the depth of the lines required to be produced. Afterwards the whole is removed and reapplied, &c., as with the usual etching fluids. The same etching-paste, by being kept for a few days, again acquires the property of dissolving iron, and may be used again and again; but independently of this, the iodide of iron formed during the process, if rapidly evaporated to dryness in a clean iron vessel by a moderate heat, and placed in stoppered bottles, will sell for more than the original cost of the iodine. To travellers and amateurs iodine, from its portability and convenience, is especially useful for marking surgical instruments, razors, and other edge-tools" (*A. J. Cooley*).

Etching, Electro-. This mode of etching, which is in many respects superior to the ordinary mode, is based upon the destructive action of certain 'anions' during 'electrolysis.' If two plates of copper be connected with the opposite ends of a voltaic battery, and placed in a vessel containing very dilute sulphuric acid, the plate connected with the copper of the battery will be attacked by the anion oxygen which is released during the decomposition of the acid. This destructive action can be localised at pleasure by covering certain parts of the plate with a protecting stratum of varnish, ordinary 'etching ground' for instance. In the practice of electro-etching, the drawing is 'scratched in' in the usual way through an ordinary ground; a stout wire is then soldered to the plate, and this, as well as the back of the plate, is coated with sealing-wax varnish. Thus prepared, the plate is placed in a suitable 'decomposition cell' opposite a plate of somewhat similar size, and the two are connected respectively with the copper and zinc of a 'Daniell's cell,' or the silver and zinc of a 'Smee's cell.' After about 10 minutes the plate is removed, washed, and dried; and when the 'fine work' has been stopped out with Brunswick black, it is returned for another space of 10 minutes. By alternately exposing the plate to action of the decomposing fluid, and 'stopping out' parts of the work, the required gradation in tints is obtained. The exact duration of the various exposures, as well as their number, must, of course, be regulated by circumstances. See ETCHING FLUIDS (*below*).

Etching Fluids. 1. (FOR COPPER.) *a.* From 'aquafortis,' 2½ fl. oz.; water, 5 fl. oz.; mix.

b. To the last add of verdigris, 1 oz.; water, 2½ fl. oz.; dissolve. For light touches.

c. (EAU FORTE, *Callott* and *Piranesi*.) Alum, sal-ammoniac, sea salt, and verdigris, of each, 4 oz.; vinegar (pyroligneous acid), 8 fl. oz.; water, 16 fl. oz.; mix, dissolve, boil for 1 or 2 minutes in a glazed or stoneware vessel, cool, and decant the clear portion. Used as the last.

d. Water acidulated with sulphuric acid. Used in the process of electro-etching.

2. (FOR STEEL.) *a.* From iodine, 1 oz.; iron filings or wire, ½ dr.; water, 4 fl. oz. It must be kept in a stoppered bottle until required for use.

b. From iodine, 3 dr.; iodide of potassium, ½ dr.; proof spirit, 1 fl. oz.; water, 2 fl. oz. As the last.

c. (*Mr Turrel.*) Pyroligneous acid, 4 fl. oz.;

alcohol (rectified spirit), 1 fl. oz.; mix, and add of nitric acid or double aquafortis (sp. gr. 1·28), 1 fl. oz.

d. From hydrochloric acid, 5 parts; water, 95 parts; mix, and add the liquid to a solution of chlorate of potassa, 1 part, in water, 50 parts.

e. A solution of common salt. Used in the process of electro-etching.

Etching Ground. *Syn.* ETCHING VARNISH. *Prep.* 1. Beeswax, 5 parts; linseed oil, 1 part; melted together.

2. (*Callott's* HARD VARNISH, FLORENTINE V., FLORENCE V.) From linseed oil and mastic, equal parts, melted together.

3. (*Callott's* SOFT VARNISH.) From linseed oil, 4 oz.; gum benzoin and white wax, of each, ½ oz.; boil to 2-3rds.

4. (*Lawrence.*) White wax, 2 oz.; black pitch and Burgundy pitch, of each, ½ oz.; melt, add by degrees of asphaltum, 2 oz.; and boil together, until a piece, when thoroughly cold, will break by being bent double 2 or 3 times between the fingers; next pour it into warm water, make it into small balls, and place each of them in a piece of taffety for use.

Obs. The preceding compositions are applied to the surface of the plates, previously made sufficiently warm to melt them easily, their even diffusion being promoted by dabbing them with a wad of cotton. Those that are white are then generally blackened on the surface by skilfully passing them over the smoky flame of one or more candles, by which the marks of the etching point on the bright metal are rendered the more visible.

For other processes see PHOTOGRAPHY.

ETHER. *Syn.* OXIDE OF ETHYL. Described under ETHYL, OXIDE OF. Several substances are known under the name of ethers besides the true ethers or salts of ethyl, and are given below.

Ether of Canthar'ides. *Syn.* ÆTHER CANTHARIDALIS, L. *Prep.* (*Œttinger.*) From powdered cantharides, 1 part; ether, 2 parts; digested together for 3 or 4 days, and the tincture expressed. Used as a vesicant, &c.

Ether, Chlo''ric. This name was applied by Dr T. Thomson to the CHLORIDE OF OLEFIANT GAS, or 'DUTCH LIQUID;' and afterwards by Guthrie and Silliman, to CHLOROFORM, which they took for an alcoholic solution of chloride of olefiant gas. It now forms one of the synonyms of chloroform. The medicinal 'CHLORIC ETHER' of the shops was a solution of chloroform, 1 part, in rectified spirit, 8 parts. In the British Pharmacopœia chloric ether is mentioned as a synonym for spirit of chloroform, of which the *dose* is 20 or 30 drops in water, as an antispasmodic and anodyne. See CHLOROFORM.

Ether, Chlorinet'ted. Formed by the action of dry chlorine on pure ether. When the action is long continued, a heavy, oily product (BICHLORINETTED ETHER), smelling like fennel, is formed. By the still further action of chlorine, aided by sunlight, a white crystalline substance (PENTACHLORINETTED ETHER), a compound resembling sesquichloride of carbon, is obtained.

Ether, Methy'lic. *Syn.* OXIDE OF METHYL, WOOD-ETHER, METHYL-ETHER; ÆTHER METHYLICUS, L. *Prep.* From wood spirit, 1 part; concentrated sulphuric acid, 4 parts; mix in a retort, apply heat, pass the evolved gas (methylic ether) through a little strong solution of potassa, and then collect it over mercury. See METHYL.

Ether, Spirits of Nitrous. See SPIRITS.

Ether, Washed. *Syn.* ÆTHER LOTUS, L. Ordinary ether, agitated first with 2 or 3 times its volume of distilled water, and a few grains of carbonate of potassa, or a few drops of milk of lime; and after decantation, again agitated with a like quantity of water only. Used for inhalations. For other purposes the washed ether is afterwards digested on chloride of calcium, to deprive it of retained water.

E'THERIN. *Syn.* CAMPHOR OF OIL OF WINE. A volatile, white, crystalline substance, deposited by light oil of wine when left in a cold situation for some time. It is isomeric with etherole, and received its name from the assumption of its being the base of the ethereal compounds. According to this hypothesis, ether is a hydrate of etherin. Etherin forms brilliant prisms and plates; is tasteless; soluble in alcohol and ether; fuses at 230° F., and boils at 500° F.; and is a little lighter than water. The crystals are purified by pressure between the folds of bibulous paper, solution in ether, and evaporation.

E'THEROLE. The yellowish, oily liquid, forming the residual portion of light oil of wine, after it has deposited its etherin. It is lighter than water; is freely soluble in both alcohol and ether; and has a rather high boiling-point. See ETHERIN and OIL OF WINE.

ETHION'IC AC'ID. *Prep.* An alcoholic solution of the crystals of sulphate of carbyle (ethionic anhydride, see *below*) is diluted with water, the whole neutralised with carbonate of baryta, the filtered liquid evaporated by a very gentle heat to a small bulk, and a large quantity of alcohol added; the precipitate (ethionate of baryta) is treated (cautiously) with dilute sulphuric acid (avoiding excess), by which the baryta is withdrawn, and ethionic acid left in solution.

Prop., &c. Ethionic acid is decomposed by heat. Its salts (ethionates) are all soluble in water, and are said to be anhydrous. The ethionates of ammonia, potassa, and soda crystallise readily; those of lead, baryta, lime, and the other earths are uncrystallisable. See ISETHIONIC ACID and *below*.

ETHION'IC ANHY'DRIDE. *Prep.* Pure and dry olefiant gas is passed over sulphuric anhydride contained in a U-shaped tube. Or sulphuric anhydride vapour is passed through anhydrous alcohol. It is identical with carbyle sulphate. It combines with water, forming ethionic acid.

E'THIOPS. *Syn.* ÆTHIOPS, L. A name given by the older chemists to several black powders on account of their colour, and still occasionally employed in medical works.

Ethiops, Graphi'tic. *Syn.* ETHIOPS OF PLUMBAGO; ÆTHIOPS GRAPHITICUS, L. From plumbago, 2 parts; quicksilver, 1 part; triturated together until the globules disappear.—*Dose*, 5 to 10 gr.; in herpes, and some other obstinate skin diseases.

Ethiops, Martial. Black oxide of iron prepared by keeping iron filings under water, and occasionally shaking them. It is washed with water, dried

as quickly as possible, and preserved from the air, to prevent further oxidation. Formerly much esteemed as a tonic.

Ethiops, Min′eral. *Syn.* ETHIOPS MINERAL; ÆTHIOPS MINERALIS, HYDRARGYRI SULPHURETUM CUM SULPHURE, L. Black sulphuret of mercury, with excess of sulphur.

(*Tyson's.*) Oxide of mercury (prepared by decomposing calomel with an equivalent proportion of liquor of potassa to which a little liquor of ammonia has been added) and flowers of sulphur, equal parts, triturated together. This is recommended as an efficient substitute for the old and uncertain preparation commonly sold under the name of *Ethiops mineral.* It is, however, of more than double the usual strength, and should therefore be taken in proportionate doses. See MERCURY (Sulphide).

Ethiops, Vege′table. *Syn.* ÆTHIOPS VEGETABILIS, PULVUS QUERCÛS MARINÆ, L. Bladder wrack (*Fucus vesiculosus*), burned in a close vessel till it becomes black and friable. Used in bronchocele, scrofula, &c. Like burnt sponge, it owes its virtues to the presence of a very minute quantity of iodine.—*Dose,* 20 gr. to 1 dr. or more, made into an electuary with honey or sugar.

E′THYL, C_2H_5. The hydrocarbon assumed to be the radical of the ether-compounds (ethyl-series); it has never been isolated. A body containing carbon and hydrogen in the proportions indicated by the formula of ethyl, $2(C_2H_5)$, has been obtained by exposing dry iodide of ethyl in sealed tubes for several hours to the action of finely divided zinc, at a temperature of from 320°—338° F.; this is *butane,* C_4H_{10}.

According to the beautiful theory of Liebig, ethyl is a 'salt-basyle,' forming 'haloid salts' with chlorine, iodine, and bromine; its oxide is ether, and the hydrate of this oxide alcohol. The compound ethers are analogous to ordinary salts in which the metal is replaced by the radical ethyl.

Ethyl, Oxide of $(C_2H_5)_2.O$. *Syn.* ETHER, SULPHURIC ETHER, ÆTHER (B. P.), ÆTHER SULPHURICUS (Ph. E. D. & U. S.), Æ. RECTIFICATUS, Æ. VITRIOLICUS, Æ. SPIRITUS VITRIOLI DULCIS, L. A colourless, highly volatile, fragrant-smelling, inflammable liquid, obtained by distilling a mixture of sulphuric acid and alcohol. It was not known before the 13th century.

Prep. There are two methods employed for the preparation of ether. The one is by mixing the whole of the ingredients at once, and immediately subjecting them to distillation at a proper temperature; the other is by adding the alcohol in a slender streamlet to the acid, previously heated to the etherifying point.

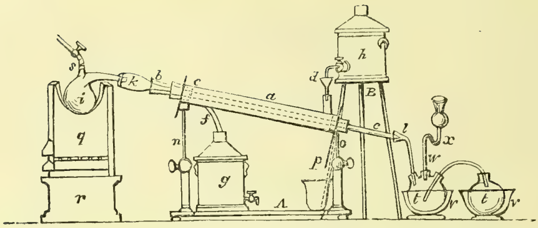
1. Rectified spirit, 3 lbs.; sulphuric acid, 2 lbs.; carbonate of potash (previously ignited), 1 oz.; pour 2 lbs. of the spirit into a glass retort, add the acid, and place the vessel on a sand-bath, so that the liquor may boil as quickly as possible, and the ether, as it forms, pass over into a well-cooled receiver; continue the distillation until a heavier fluid begins to pass over, then lower the heat, add the remainder of the spirit, and distil as before; mix the distilled liquors together, pour off the supernatant portion, add the carbonate of potash, and agitate occasionally for 1 hour; finally, distil the ether from a large retort, and keep it in a well-stoppered bottle. Sp. gr. ·750.

2. *Continuous Etherification Process.* The strongest oil of vitriol, 3 parts, are mixed with alcohol, q. s. (about 2 parts at ·830) to reduce its sp. gr. to 1·780; an object which may be easily obtained by distilling off some of the ether if required. The still or retort is then connected with a vessel full of alcohol, of at least 90%, by means of a small syphon tube, furnished with a stopcock; the longer limb of which should be of glass, and so arranged that it just dips into the mixture of acid and alcohol. Heat is next applied, and the contents of the still raised to the boiling-point as rapidly as possible, and as soon as full ebullition commences the stopcock of the siphon is cautiously turned, so as to allow the alcohol to flow down in such a manner as to keep the boiling liquid exactly at the same level; or, in other words, to supply a quantity of alcohol exactly equal to that of the liquid which distils over. By careful manipulation the whole of the alcohol which enters the retort passes over as ether and water, and this decomposition proceeds for some time, and would continue for an unlimited period did not the sulphuric acid ultimately become too weak to form ether, owing to the gradual absorption of the superfluous water contained in the alcohol. Were it convenient or practicable to use absolute alcohol, a given weight of sulphuric acid of the proper strength would maintain the power of producing ether for an indefinite period. In practice, the quantity of alcohol that may thus be etherified is twice or thrice as much as by the other process, while the product is much purer, and the residual liquid of the distillation continues limpid, and has only a pale-brown colour. This is termed the 'continuous' or 'Boullay's' method. (This process is similar to that given in the B. P.)

The continuous etherification process was first explained by Williamson; a compound $C_2H_5.HSO_4$, ethylsulphuric acid, is first formed, which is decomposed by the action of more alcohol, forming ether $(C_2H_5)_2O$, and sulphuric acid, H_2SO_4.

Obs. The mixture of alcohol with sulphuric acid requires some caution. It is best done by introducing the alcohol into a suitable vessel, and imparting to it a rapid whirling motion, by which a considerable conical cavity is formed in the centre, and into which the acid may be gradually poured with perfect safety. The mixed fluids should be brought to a state of rapid ebullition as quickly as possible, as without this precaution much of the alcohol distils over before the liquor acquires the proper temperature for etherification. On the small scale a tubulated retort, connected with a Liebig's condensing tube and two globular receivers surrounded with a freezing mixture, or ice-cold water may be employed as the distillatory apparatus. The second receiver should be connected with the first one by means of a bent glass tube, reaching nearly to the bottom of the former; and the whole of the joints should be securely luted as soon as the air has been allowed to escape.

For the rectification of ether, a water-bath is employed along with the above simple refrigerator,



a. Condenser tube.
b, c. Glass tube.
d. Funnel by which cold water runs in from the water bottle *h*.
e. Pipe by which water escapes through *f* into the bottle *g*.
i. Retort.
k. Adapter, connecting the retort with the condenser.
l. Adapter, connecting the condenser with the bottles *t, t*.
A. Wooden trestle, with movable arms, *n, o,* for supporting and adjusting the heights of the condenser.
B. Wooden stool for supporting the water bottle.
p. Gutter for carrying off water that overflows the funnel *d*, and preventing its escape along the pipe *c*.
q. Furnace.
r. Support for the furnace.
s. Leg of syphon connected with bottle containing alcohol.
t, t. Glass globes, placed in the basins *v, v,* and surrounded with pounded ice or ice-cold water.
w. Safety tube, containing a little mercury at *x*.

and the receivers surrounded by ice or a freezing mixture.

Chem. Comp., &c. Ether is regarded as the oxide of ethyl, and alcohol as the hydrate of this base. The composition of alcohol is expressed by the formula $C_2H_5.OH$, while the formula for ether is $(C_2H_5)_2O$. Ether may be converted into alcohol by heating it with water and a small quantity of sulphuric acid, direct union of the ether and water taking place.

The compound ethers may be compared to ordinary salts in which the metal is replaced by a radical termed ethyl, having the formula C_2H_5. This view is, of course, in accordance with the theory which regards ether as the oxide of ethyl.

According to theory, 1 equivalent, or 46 parts of absolute alcohol, should produce 1 eq., or 37 parts of pure ether; but in practice, the greatest product obtained by operating according to Boullay's method, which produces more ether than any other, does not exceed 33½ parts for the preceding quantity of alcohol, or 71·5%. A mixture of 9 parts of oil of vitriol, and 5 parts of alcohol of 90%, ceases to produce ether after 31 parts of such alcohol have been added.

Prop., Uses, &c. Pure ether is a colourless, transparent, and very limpid fluid, having a penetrating and agreeable smell, and a burning, sweetish taste; its rapid evaporation produces a very low temperature. Its specific gravity varies between ·712 and ·724. If it contains water it begins to crystallise in brilliant white plates when cooled to − 24° F., and becomes a white crystal mass at − 46° or − 47° F.; but if absolutely pure, ether cannot be solidified by any degree of cold that can be produced, it remaining fluid when placed in contact with solid carbonic acid, at a temperature about − 148° F. Boils at 95° F.; is very combustible; is soluble in about 10 parts of distilled water, and mixes with alcohol in all proportions. It abstracts corrosive sublimate, trichloride of gold, ferric chloride, and many of the alkaloids, from their watery solutions, and is hence invaluable in *analysis* and *pharmacy*. It readily dissolves the volatile and fixed oils, and most fatty matters, as well as sulphur and phosphorus in small quantities. By exposure to light and air it absorbs oxygen, and water and acetic acid are gradually formed. It is decomposed by exposure to a high temperature. Its evaporation occasions intense cold. The greatest degree of cold yet produced (− 166° F.) has resulted from the admixture of ether with solid carbonic acid. Ether is powerfully stimulant, narcotic, and antispasmodic, if allowed to evaporate, or stimulant and counter-irritant if its evaporation is prevented, and is used in various diseases. Applied to the forehead by means of the fingers or a strip of linen, it generally relieves simple cases of nervous headache. In *pharmacy*, it is largely employed in the preparations of tinctures, alkaloids, spirits, &c.; and in *chemistry*, is invaluable in organic analyses. Its principal commercial application is as a solvent for pyroxylin, in the manufacture of collodion. It is also employed as a solvent of resins, india rubber, &c., in the preparation of varnishes, and for several other useful purposes.—*Dose*, 20 drops to 2 fl. dr.; in water or wine. Excessive doses of ether produce intoxication resembling that from alcohol, and require similar antidotes. Sulphuric ether is said to be taken largely in the north of Ireland as a stimulant, particularly in Antrim. Shortly before the discovery of chloroform, it was found that when the vapour of ether was inhaled it gradually produced insensibility to pain. It was therefore employed as an anæsthetic in surgical operations. It is now mixed with alcohol and ether for use as an anæsthetic; a common mixture consists of 1 part of alcohol, 2 of chloroform, and 3 of ether.

Tests. Ether may be recognised by its volatility, odour, taste, sparing solubility in water, admixture with alcohol in all proportions, great inflammability (burning with a yellowish-white flame), and its power of dissolving fats and resins. Its further identification can only be effected by ultimate analysis.

Pur. The ether of the shops generally contains alcohol, water, or acetic acid, and sometimes all of them. It may be purified from water by allowing it to stand with calcium chloride or potassium carbonate, and distilling. It may be freed from alcohol and acetic acid by distillation with sodium, until hydrogen ceases to be evolved. Its usual specific gravity fluctuates between ·733 and ·765. Exposed to the air, it volatilises entirely. Ordinary ether often turns

litmus-paper red. Pure ether, however, is neutral to test-paper. 10 parts of water by volume dissolve 1 part of ether without becoming cloudy. Water may be detected in ether by shaking it with an equal volume of carbon bisulphide; the liquid will become turbid if any water is present. To detect alcohol, the ether is shaken with aniline violet, when it remains uncoloured if alcohol is absent.

Preserv. Ether rapidly evaporates at common temperatures when kept in corked bottles, and even in bottles secured with ground-glass stoppers and tightly tied over with bladder and leather. To prevent this waste, the stoppers should fit accurately, and the bottles should be placed in as cool a situation as possible. Bottles furnished with ground-glass caps, as well as stoppers, are frequently employed (see *engr.*). Dewar's 'ether phial' is formed on a similar principle. We have seen bottles of ether accurately stoppered, tied over with bladder, and thickly coated with wax, which have yet become quite empty by a voyage to the tropics, though they still appeared to be as closely secured as when they were first filled.

Caution. The vapour of ether is very inflammable, and when mixed with atmospheric air it forms a violently explosive mixture. The density of this vapour is 2·586, that of air being 1; hence it rapidly sinks, and frequently accumulates in the lower parts of buildings, especially cellars, which are badly ventilated, in the same way as water does. The only remedy is thorough ventilation. Many serious accidents have arisen from this cause, for no sooner is a light carried into an apartment where such vapour is present than an explosion takes place.

Ethyl, Acetate of. $C_2H_5.C_2H_3O_2$. *Syn.* ACETIC ETHER, PYROLIGNEOUS ETHER; ÆTHER ACETICUS, L. A compound discovered by Count de Lauraguais in 1759.

Prep. 1. Acetate of potash, 3 parts (or an equiv. quant. of acetate of soda); alcohol (85°/ₒ), 3 parts; oil of vitriol (strongest), 2 parts, are mixed together, and distilled by the heat of a sand-bath, from a glass or earthenware retort into a well-cooled receiver; the distillate is agitated with a little water to remove undecomposed alcohol, and then digested first with a little chalk to remove sulphuric acid, and afterwards with fused chloride of calcium to absorb water; it is, lastly, rectified by a gentle heat.

2. Rectified spirit (sp. gr. ·84), 50 parts; acetic acid (sp. gr. 1·075), 33 parts, are mixed together, and oil of vitriol (strongest), 10 parts, added; the distillation is continued until 65 parts have passed over, and the distillate, after digestion for some hours with a little dry carbonate of potassium, is rectified as before, the first 50 parts only being kept for use.

Prop., &c. Acetic ether is colourless, and bears a considerable resemblance to ordinary ether, but it has a much more agreeable and refreshing odour. It boils at 165° F.; has a sp. gr. of ·89 at 60° F.; dissolves in about 7 parts of water; and mixes in all proportions with alcohol and ether. It is decomposed by alkalies and the strong acids.

Acetic ether is diaphoretic, stimulant, antispasmodic, and narcotic.—*Dose,* ½ to 2 fl. dr.; in similar cases to those in which sulphuric ether is employed, and especially in nervous and putrid fevers, spasmodic vomitings, and diseases of the bowels and stomach, arising from debility and not of an inflammatory character. Its principal consumption is in the manufacture of British brandy.

Ethyl, Benzoate of. $C_2H_5.C_7H_5O_2$. *Syn.* BENZOIC ETHER; ÆTHER BENZOICUS, L. *Prep.* Alcohol (sp. gr. ·830), 4 parts; benzoic acid (cryst.), 2 parts; concentrated hydrochloric acid, 1 part, are distilled together; as soon as the product turns milky when mixed with water, the receiver is changed, and the liquid that distils over collected; to this liquid water is added, and the supernatant ether is decanted and boiled with water and a little oxide of lead (to separate benzoic acid); it is, lastly, freed from water by allowing it to stand over chloride of calcium.

Prop., &c. A colourless oily liquid, slightly heavier than water, and possessing an aromatic odour and taste. It boils at 410° F., and is miscible with alcohol and ether.

Ethyl, Bromide of. C_2H_5Br. *Syn.* ÆTHER HYDROBROMICUS, L. A volatile, ethereal liquid, discovered by Serullus.

Prep. Bromine, 8 parts; alcohol, 32 parts; dissolve, place the mixture in a retort, add of phosphorus, 1 part, and distil by a gentle heat as soon as the liquid becomes cold. The ether is separated from the distillate by the addition of water. Phosphorus tribromide, PBr_3, is formed; this acts upon the alcohol, forming ethyl bromide and phosphorous acid.

Prop., &c. A very volatile liquid, with a penetrating taste and smell; boiling at 105° F., and heavier than water.

Ethyl, Bu'tyrate of. $C_2H_5.C_4H_7O_2$. *Syn.* BUTYRIC ETHER, PINE-APPLE OIL; ÆTHER BUTYRICUS, L. *Prep.* By passing hydrochloric acid gas into an alcoholic solution of butyric acid, and purifying the product from free acid.

Commercially, from crude butyric acid neutralised with caustic potash or baryta, and the resulting solution distilled together with alcohol and oil of vitriol.

Uses. Crude butyric ether forms the 'pine-apple oil' of commerce, and when largely diluted with rectified spirit, the 'pine-apple essence' so much employed as a flavouring substance by confectioners, liqueuristes, &c. It imparts a delicious flavour to sweetmeats, rum, arrack, punch, &c. The Germans add it to common rum, to form the flavouring for their 'pine-apple ale.'

Ethyl, Carbonate of. $(C_2H_5)_2CO_3$. *Syn.* CARBONIC ETHER; ÆTHER CARBONICUS, L. *Prep.* Fragments of sodium are added to oxalic ether, gently warmed, as long as bubbles of gas (carbonic acid) are formed; the excess of metal is removed from the semi-solid mass, some water added, and the whole distilled. The carbonic ether floats on the surface of the liquid in the receiver, and is collected, dried by contact with chloride of calcium, and rectified along with some potassium or sodium, till it ceases to yield acetate of potash when acted on by caustic potash.

Prop., &c. Colourless, limpid liquid, with an

aromatic odour; tastes pungent and burning; boils at 259°—260° F. It greatly resembles oxalic ether. It is decomposed by alkalies.

Ethyl, Chlo'ride of. C_2H_5Cl. *Syn.* LIGHT HYDROCHLORIC E., CHLORIDE OF ETHYL; ÆTHER HYDROCHLORICUS, L. A highly volatile compound, formed of ethyl and chlorine.

Prep. Rectified spirit of wine is saturated with dry hydrochloric acid gas in the cold, and the product is distilled in a retort connected with a Wolfe's apparatus, the first bottle of which should be 2-3rds filled with tepid water (70°—75° F.), and the remainder surrounded with a mixture of ice and salt. To render it perfectly anhydrous, it must be digested with a few fragments of fused chloride of calcium.

A mixture of oil of vitriol, 3 parts, and alcohol, 2 parts, is poured upon common salt (dried), 4 parts; and the whole distilled as before.

Prop., &c. It has a sweetish taste; is soluble in about 15 parts of water, and miscible in all proportions with alcohol; boils at 54° F.; burns with a flame edged with green; is neutral to test-paper, and does not affect a solution of nitrate of silver. Sp. gr. ·921 at 32° F.—*Dose,* 10 to 30 drops, as an antispasmodic and a powerful diffusible stimulant. Owing to its extreme volatility it can only be taken dissolved in spirit.

Ethyl, Cy'anate of. C_2H_5CNO. *Syn.* CYANIC ETHER. *Prep.* By distilling a dry mixture of cyanate of potash, and potassium ethyl sulphate, in nearly equivalent proportions. A mixture of cyanic and cyanuric ethers passes over into the receiver. By distilling this mixture the two are readily separated; that which passes over by the heat of a water-bath being the first, and the residuum in the retort the second.

Prop., &c. An ethereal, very mobile liquid, boiling at 140° F.

Ethyl, Cy'anide of. C_2H_5CN. *Syn.* ÆTHER HYDROCYANICUS, L. *Prep.* Cyanide of potassium and potassium ethyl sulphate, equal parts, are mixed and distilled in a glass retort by a moderate heat. The product separates into two strata; the lighter one is impure ethyl cyanide; this is decanted and agitated with 4 or 5 times its bulk of water at 120°—140° F., and the operation is repeated with about 2 parts of water; the ether is again decanted, and placed in contact with chloride of calcium for 24 hours, and then rectified.

Prop., &c. It boils at 190° F. Sp. gr. ·788. In its therapeutical effects it resembles hydrocyanic acid, but is less active. Its odour is, however, more penetrating and offensive.—*Dose,* 2 to 6 drops, in mucilage or emulsion; in obstinate or convulsive coughs, gastrodynia, hysterical affections, &c.

Ethyl, Cyan'urate of. $(C_2H_5)_3C_3N_3O_3$. *Prep.* See CYANIC ETHER.

Prop., &c. Tasteless, inodorous, colourless, transparent needles and prisms; fusing at 185° F.

Ethyl, I'odide of. C_2H_5I. *Syn.* ÆTHER HYDRIODICUS, L. *Prep.* Phosphorus, 4 parts, alcohol (sp. gr. ·84), 70 parts, and iodine, 100 parts, are gradually and cautiously mixed together and distilled. The reaction is analogous to that which takes place in the preparation of the bromide.

Prop., &c. A colourless liquid, possessing a strong ethereal odour, and boiling at 158° F.; sp. gr. 1·92. It is reddened and decomposed by exposure to air and light.

Ethyl, Nitrate of. $C_2H_5NO_3$. *Syn.* NITRIC ETHER; ÆTHER NITRICUS, L.

Prep. Nitric acid (sp. gr. about 1·375), 50 parts; nitrate of urea, a little (say 2 or 3 parts); dissolve, add alcohol, 50 parts, and distil with the usual precautions, until 7-8ths of the whole (of the liquid portion) have passed over; agitate the distillate with a little water to separate the ether, and preserve the heavier portion.

Prop., &c. Nitric ether possesses an agreeable sweetish taste and odour; it is insoluble in water; the alcoholic (but not the aqueous) solution of potash decomposes it rapidly; sp. gr. 1·112. Its vapour is very apt to explode when strongly heated, and therefore a small quantity only should be prepared at a time.

Ethyl Nitrite. $C_2H_5.NO_2$. *Syn.* NITROUS ETHER; ÆTHER NITROSUS, L. This is a compound of which 'sweet spirit of nitre' is an impure alcoholic solution. *Prep.* 1. The best method is to pass nitrous acid gas into alcohol. The nitrous acid is prepared by acting upon such bodies as starch, copper, mercury, or arsenious acid with nitric acid. The alcohol should be as concentrated as possible, and should be kept very cold, and the current of nitrous acid gas should be slow and steady; in this way a comparatively pure product is obtained.

Nitrite of ethyl is an extremely volatile liquid; it boils at about 61° F., whereas aldehyde boils at 90° F., and alcohol at 180° F. Taking advantage of this fact, we are enabled to separate it from the crude liquid by distillation. Some precautions are, however, necessary to ensure the purity of the product. The flask containing the crude product is placed in a water-bath, and connected by bent tubes with several other flasks and bottles. The first tube should be passed into a small empty flask; this will condense most of the alcohol which may pass over during the operation. Then a second bent tube passes into a second flask containing a little water; this condenses any alcohol which may not have been stopped in the first flask, together with free acid, and nearly all the aldehyde.

From this wash-bottle a third tube proceeds into a somewhat shallow flask, containing a strong solution of caustic potash; the gas, however, is not allowed to pass through this alkaline liquid, but simply over the surface. In this way the last portion of the aldehyde is absorbed, and the potash solution gradually assumes an amber colour. From this vessel, the gas (for such, at the ordinary temperature of the laboratory, the nitrite of ethyl is—in very cold weather it would be necessary to gently warm the different flasks) is passed through a tube charged with anhydrous chloride of calcium to absorb moisture, and the pure and dry nitrite of ethyl thus produced finally passes into alcohol, which readily absorbs it.

It is only necessary to note the weight of the alcohol used for absorbing the gas, and its weight at the end of the operation, to know the strength or percentage of nitrite of ethyl which must be in solution. Ordinary spirits will answer for condensing the nitrite of ethyl, but it is

better to use absolute alcohol, as it is very desirable to avoid the presence of water in any form. The solutions made with weaker spirit soon turn acid; those made with absolute alcohol, on the other hand, keep a long time. It is very true the very strong solutions of 50% and 25% show traces of acidity when tested with moistened litmus-paper, but the 10% solution is quite neutral.

The distillation must be conducted at the very lowest possible temperature; in fact, the water in the water-bath should only be kept gently warm, and the process should be continued only so long as the conducting tubes feel cool to the touch; when they become warm the distillation should be discontinued. By passing the gas into a tube in a freezing mixture, instead of into alcohol, the pure nitrite of ethyl is readily obtained in a liquid form; it is, however, necessary to seal the tube, otherwise the very volatile liquid would soon be lost.

2. Rectified spirit, 46 parts (by volume), pure nitric acid (sp. gr. 1·5), 7 parts. Put 15 parts of the spirit into a retort, fitted with a cork and a safety tube, and with a second tube leading to a refrigerating apparatus. Fill the safety-tube with pure nitric acid, then add through it, gradually and cautiously, 3½ parts of the acid. When the action has nearly ceased, add the remaining portion of the acid, a little at a time. Ethyl nitrite distils over.

Prop., &c. Pure nitrous ether has a pale yellow colour, an agreeable odour of apples, and boils at 62° F.; sp. gr. ·947 at 60° F. Commercial nitrous ether contains aldehyde, boils at 70° F., has a more or less suffocating odour combined with that of the pure ether, has a sp. gr. of ·886 at 40° F., and turns brown when mixed with alcoholic solution of potash, while the latter remains unaltered. It also acidifies by age, whilst pure nitrous ether remains neutral. They are both very inflammable, and burn with a white flame. Ordinary nitrous ether dissolves in about 48 parts of water, and mixes in all proportions with alcohol and sulphuric ether.

Nitrous ether is refrigerant, diaphoretic, and diuretic, but is seldom employed alone, though when largely diluted with alcohol (sweet spirits of nitre, spirit of nitric ether) it is a common remedy in several diseases. It is also used to flavour malt-spirit, in imitation of brandy (British brandy), although for this purpose it is vastly inferior to acetic ether. See SPIRITS (Medicinal).

Ethyl, Œnanthate of. *Syn.* ŒNANTHIC ETHER, PELARGONIC ETHER. *Prep.* The oil obtained towards the end of the distillation of fermented liquors, especially wines, consists, in a great measure, of the crude ether. It is purified by agitation with a weak solution of carbonate of potassa, freed from water by a few fragments of chloride of calcium, and then re-distilled. It consists chiefly of ethyl caprate.

Prop., &c. Œnanthic ether is colourless, lighter than water, and boils at about 500° F.; it has a powerful, intoxicating vinous odour, resembling that of an empty wine-cask or bottle that has been exposed to the air for some time. It is very sparingly soluble in water, but freely soluble in alcohol. Its sp. gr. is ·862. As obtained by distillation, it is united with a little ŒNANTHIC ACID. 2200 imperial galls. of wine (about 35 hogsheads) only yielded 2½ lbs. of the mixed oil.

Ethyl, Oxalate of. $(C_2H_5)_2C_2O_4$. *Syn.* OXALIC ETHER; ÆTHER OXALICUS, L. *Prep.* Alcohol and dry oxalic acid, equal parts, are digested together in a glass flask connected with an inverted condenser, so that the spirit, volatilised by the heat, is condensed, and flows back into the flask. After 6 or 8 hours the process is generally complete, and the liquid contains merely a trace of free acid, from which it may be separated.

Prop., &c. A colourless, oily liquid, slightly heavier than water, boiling at 363° F., only slightly soluble in water, and having an aromatic smell. Alkalies decompose it. Sp. gr. 1·09.

Ethyl, Sulphate of. $(C_2H_5)_2SO_4$.

Prep. Sulphuric acid is added to absolute alcohol. Ice and then water are added to the mixture, and the liquid is shaken with chloroform, the sulphate is dissolved, and left behind on evaporation. It may also be prepared by the action of ethyl iodide upon silver sulphate. It is a very unstable compound, and cannot be distilled without suffering decomposition.

Ethyl, Valerianate of. $C_2H_5.C_5H_9O_2$. *Syn.* VALERIANIC ETHER; ÆTHER VALERIANICUS, L. *Prep.* By passing dry hydrochloric acid gas into an alcoholic solution of valeric acid. It is a fragrant, volatile liquid, lighter than water, having a high boiling-point, and a rich fruity odour, said to closely resemble that of butyric ether or pine-apple oil. It is used to flavour liqueurs, &c.

ETHYLAMINE. $NH_2.C_2H_5$. A compound ammonia, formed by the replacement of one of the hydrogen atoms in ammonia by the radical ethyl. It may be obtained pure by distilling diethyloxamide with caustic potash; also by reducing nitro-ethane.

It is a mobile, colourless liquid, with a strong ammoniacal smell. It burns with a yellow flame. Its specific gravity is ·6964 at 8° C.; boiling-point 19° C. (68° F.). Ethylamine decomposes ammoniacal salts with evolution of ammonia. It throws down many metallic hydroxides, as ammonia does, but may be distinguished from ammonia by the fact that precipitated aluminium hydroxide redissolves in excess of ethylamine. Salts of cadmium, nickel, and cobalt give precipitates which are insoluble in excess, while cupric hydroxide dissolves with difficulty in excess of ethylamine. It forms salts in the same way as ammonia, which it closely resembles in its general properties.

EUACANTHUS INTERRUPTUS, Linn. The Hop-jumper. This insect is often confounded with another species of the same family, *Cercopidæ*, distinguished as *Aphrophora spumaria* because the larvæ are covered with a frothy liquid, vulgarly called 'cuckoo spit,' or frog's spittle, and supposed to be caused in some mysterious manner by cuckoos and frogs. Professor Westwood states that the ancients believed that these insects were generated by the above-mentioned animals, and the tradition has been handed down to the present day. Although the frog flies, or cuckoo flies, *Aphrophora spumaria*, live by sucking the juices from plants and trees in the same way as the veritable jumper (*Eu-*

acanthus, Westwood; *Amblycephalus interruptus*, Curtis; *Euacanthus interruptus*, Linnæus), and have the same wonderful powers of leaping, these insects are specifically distinct.

An allied species, much smaller than the hop-jumper, attacks rose-trees: another is found upon lime-trees. Two other species, also smaller, the *Eupteryx picta* and the *Eupteryx solani*, infest potato-plants, and Curtis found the former upon mint, burdock, and nettles.

In America a species of leaf-hopper, belonging to the same family, does enormous mischief to grape-vines by puncturing their leaves and exhausting the juices of the plants.

Old writers upon hops, as Reynolde Scott, and Bradley, do not allude to this insect; nor do Lance and Rutley, who wrote 47 and 35 years ago, notice it as injuring hop-plants. It is only within the last 20 years that the planters have seen it in their plantations, or, at least, have connected it with the sickly condition of the plants in certain seasons. Since this time it has rapidly increased, and occasionally in recent years it has caused most serious mischief, especially where the plants have been naturally weakly or backward.

Upon banks and upon indifferently tilled land, as well as upon stony and light land, they are more troublesome, making onslaughts upon the hop-bines, generally towards the middle of May, or when they have been tied up to the poles, by thrusting their beaks into the leaves and into the tender, juicy, leading shoots, from which the sap may often be seen exuding in large drops. After a while the weaker plants turn yellow; their growth is completely arrested. The stronger plants manage to struggle upwards, but their strength and powers of production are materially diminished by the continuous drain upon them. In seasons of slack, delicate, or backward bine the consequences are very serious. When the bine is plentiful and vigorous it manages to grow away from its persecutors, but the jumpers remain and multiply, feeding upon it.

Life History. The insects appear first upon the hop-plants as small larvæ. When they have arrived at their full larval size they 'moult,' as the planters say, leaving their skins upon the leaves. Another moult occurs after the pupa stage, when the perfect winged insect is formed. In all of these stages the injury to the plants is continued. Pairing then takes place, and the female lays eggs and dies. It is not clear where the eggs are deposited, nor has it been ascertained whether the life of the insect is carried on by eggs through the winter, or by hibernating larvæ. Some of the species of this family deposit eggs under the rind of plants in the autumn, which are hatched in the early spring, as the *Typhlocyba rosæ*. Another, *Jassus sexnotatus*, according to Taschenberg, lays them either in the ground or upon the roots of plants just below the surface of the ground. Harris speaks of a species, *Tettigonia vitis*, in America, whose larvæ retire for shelter during the winter beneath fallen leaves, decaying tufts, and roots of grass. Reasoning, then, by analogy, and from what is actually known of these jumpers, it seems certain that they are concealed in egg or larval form close to the hop-plant centres, in the ground or within the cracks of the poles, during the winter. Their continuity of existence is not carried on by means of eggs upon or under the rind of the hop-plants, because these are cut down in the autumn and carried away. The plant-centres, or perennial stocks, remain, with pieces of bine upon them only a foot in length, and small pieces of bine get broken off and lie on the ground throughout the winter. Their rind shrivels up, and the eggs, if under it, would be destroyed. The poles, which remain upon the ground, stacked close to the hop-plants, are said to be depositories of the insect, either in egg or larval form. One plantation was so much infested with jumpers that it was grubbed, and the poles were removed to another ground till then free from jumpers; this was soon after as badly troubled with them as the old plantation.

As its name implies, this insect, in common with others of the *Cercopidæ*, has wonderful powers of leaping, with hind legs disproportionately long, and furnished with well-developed muscles.

The colour of the perfect insect is yellowish, with markings of brown on the wings, head, abdomen, and legs, varying somewhat in position and intensity. In the pupa stage further variations of colour may be noticed. Some specimens have been seen with crimson markings.

Prevention. The roots and stocks of hop-plants, forming plant-centres or 'hills,' remain in the ground for many years, and consist of congeries of interlaced fibres, affording succulent food for the larvæ, and convenient shelter for the eggs and larvæ of insects. Though without doubt many of them would be affected and decreased by application of caustic and disagreeable substances dug in round the plant-centres, there are some which would escape; still it would be desirable, after a bad attack of jumpers, to 'open round' the plant-centres—that is, to clear away the earth from them, leaving a trench round the fibrous stocks, which would lie exposed during the winter. Planters adopted this course formerly after a visitation of mould or mildew to let the air in and to destroy the germs or spores of the fungus. Caustic substances could then be put close to the stocks, as lime, lime ashes, soot, nitrate of soda, sulphate of ammonia. Dressings of sand, sawdust, wood ashes, or finely triturated earth, with which paraffin oil should be mixed. might be sprinkled all round the stocks with very much advantage. Opening in the manner described would be very effective, but if this could not be done the soil all round the stocks should be well dug and pulverised as early as possible directly after the poles had been set up, and caustic substances put on before the digging operation.

Remedies. When the jumpers are in full force upon the hop-plants the only remedy available, or that has been proved to be practical and effectual, is to hold tarred boards or tarred sacking on two sides of the plants low down in the alleys, and to have the poles tapped smartly with a stout stick. The insects, which are very timid, as may be seen by the way they dodge round the poles, take a mighty leap after this shock and jump into the tar. Thousands can be caught by this means

in a day in badly infested plantations. Washing with soap and water does not seem to have much effect upon them ('Reports on Insects Injurious to Crops,' by Charles Whitehead, Esq., F.Z.S.).

EUCALYP'TIN. A peculiar substance existing in Botany Bay kino. A substance exuded by several species of the *Eucalyptus*. It has been employed medicinally in diarrhœa.

EUCALYPTOL. See EUCALYPTUS.

EUCALYPTUS. The *Eucalypti*, of which there are many species, belong to the Nat. Ord. MYRTACEÆ, and are natives of Australia, where they are known under the name of 'gum-trees,' or as 'stringy-bark trees.' The most interesting and important characteristic of these plants is the power they undoubtedly possess of correcting, if not of removing, the pestilential exhalations which are regarded as the origin of the fevers that occur in marshy localities. This discovery is due to M. Ramel, and was made by him in 1856.

M. Gimbert, amongst other cases, cites one of a farm, 20 miles from Algiers, the atmosphere surrounding which was of a very pestilential character. In the spring of 1867 13,000 eucalyptus trees were planted on the farm, and M. Gimbert states that since then not a single case of fever has taken place, the freedom from disease occurring the same year the plants were placed in the ground, and the good effects commencing whilst the trees were only 2 or 3 metres in height.

The following is extracted from 'Les Mondes' (1876):—"Between Nice and Monaco there is a locality so unhealthy that the Paris, Lyons, and Mediterranean Railway Company have been obliged to change every 2 or 3 months the watchman at a crossing there.

"Plantations of the eucalyptus have been formed there, and at present the same watchman has resided there for several months with his family without experiencing the least inconvenience."

At Tre Fontane, about 3 miles from Rome, large plantations of eucalyptus have been made by the Trappist monks, and the place is now habitable all the year round, and, though still unhealthy, it is no longer deadly, as it was in 1874. How far the eucalypti have been the means of bringing about this result is difficult to determine.

It seems very probable that the effects above described are due to the eucalyptus having such extensive and far-spreading roots, which suck up and appropriate the moisture of the surrounding soil, the presence of which, aided by heat, is believed to be a cause of malarial poisoning.

The avidity of the plant for water is very great; it has been computed that one tree will absorb ten times its weight of moisture from the soil ('Pharm. Journal,' Feb. 5th, 1876). It is most likely owing, at any rate in very large measure, to this cause rather than to the supposed antiseptic and disinfecting odours exhaled by its leaves that the salubrious effects of the eucalyptus are due. The blue gum-tree, or *Eucalyptus globulus* (so distinguished because of the rounded form of the lid which covers its unexpanded flower-bud), has been successfully introduced into Asia, Africa, and Southern Europe. If, as asserted, it can only exist in a climate where the temperature is never lower than the freezing-point, its domestication (save in hothouses) is impossible in our own country. [The plantations at Tre Fontane have suffered very severely from frost on one or two occasions.—ED.]

The *Eucalyptus globulus* is a very rapidly growing tree, and "in some cases it has been known to attain the colossal dimensions of 350 feet in height and 100 in circumference" (*Bentley*).

This magnitude is entirely out of proportion to the size of the seed, which is very minute; so minute that it has been computed 1 lb. weight of the seed could produce 162,000 trees. Various preparations of the leaves and bark of the eucalypti have been introduced into *medicine*, which will be found under the respective pharmaceutical preparations. They were asserted to be specially serviceable in intermittent fevers and bronchitis. The idea that their efficacy in the former class of disease was due to the presence in the barks of the eucalypti of an alkaloid similar to if not the same as quinine, has been shown to be an erroneous one, from the experiments of the Government chemist of Ootacamund (Mr Broughton), who, after a most careful chemical analysis, failed to discover either quinine, quinidine, cinchonine, cinchonidine, or the least trace of any one of the cinchona alkaloids.

When the leaves of the *Eucalyptus globulus* are held to the light they reveal the presence of little semi-transparent dots, which are found to be receptacles for a volatile oil that may be obtained in large quantity by submitting the plant to aqueous distillation.

This volatile oil has been examined by Cloez, who found it to consist chiefly of a substance allied in chemical characters to camphor, which substance he named *eucalyptol.* Any therapeutic power possessed by the eucalyptus may be referred to this substance, since, as just stated, it cannot be due to a bark alkaloid.

Before finishing our notice of the reputed curative effects of the eucalyptus we may mention that Dr Gimbert employs the leaves instead of lint for dressing wounds and fœtid ulcers, and says he has found them, when thus used, excellent deodorisers; that another method of employing the leaves of the eucalyptus consists in having them made into cigarettes, which are reported to be useful in asthma and bronchial complaints. Lastly, let us state that another species of eucalyptus exudes a very astringent substance, which, from its appearance and properties being so analogous to kino, has been denominated *Botany Bay kino*. See EUCALYPTIN.

The essential oil of eucalyptus, which, according to the species of the plant from which it is obtained, varies in colour from light yellow to light blue, is now largely employed as a diluent for the more delicate volatile oils used in perfumery.

Many species of the eucalyptus yield excellent timber, possessed of great hardness and durability, and little affected by moisture. This timber has the power of resisting the attacks of insects. The wood of the eucalyptus is also very rich in potash. The maple and the elm, which are regarded as yielding a large percentage of this substance, afford only about half as much as can be obtained from the eucalyptus, this latter tree yielding 21% of potash.

The barks of different species have also been advantageously utilised for paper-making, as well as for tanning.

In this country eucalyptus seeds are reared in a greenhouse. They may be sown in a mixture of loam, peat, and ordinary soil, with a sprinkling of sand on the surface.

The following directions for the cultivation of the eucalyptus in England were communicated to the 'Medical Times and Gazette' of 1873 by Mr Bennett Stanford, of Pyt House, Tisbury:—"I have successfully reared from seed two dozen of these trees, and they are now growing well out of doors. I obtained the seed five years ago from South Australia, and forced it in a hothouse; in one year it was 4 feet high, and now, in its fifth year, it is growing rapidly in a sheltered position in the park, having attained a height of 30 feet. The first three years the tree must be taken under cover in the winter, and the fourth and fifth years should be protected for several feet up with wisps of hay or straw. When the trees are kept indoors in winter it should be in an orangery or very high greenhouse, with plenty of light and a little water."

EUCHLO″RINE. The gas evolved on heating potassium chlorate with hydrochloric acid. It has a yellow colour, and a smell which can hardly be distinguished from that of chlorine. It was formerly supposed to be a definite oxide of chlorine, but has now been proved to be a mixture of chlorine tetroxide and chlorine. It is a powerful oxidising agent, and is frequently used in analytical *chemistry*, especially to destroy organic matter.

EUGLENÆ. These are ciliated infusorial animalcules inhabiting ponds and water-tanks. Sometimes they abound in water in quantities so enormous as to impart to that fluid a blood-red appearance. The principal species are the *Eugleda viridis* and the *Eugleda pyrum*. Their presence is supposed to indicate the existence, in the water in which they are found, of decaying animal and vegetable matter, upon which they are believed to feed.

EUPHOR′BIUM. *Syn.* Gum-euphorbium; Euphorbium (Ph. E.), L. The concrete resinous juices of the *Euphorbia canariensis* and other species of the same genus. It is a powerful acrid, purgative, rubefacient, sternutatory, and vesicant, and the violence of its action has led to its disuse.

EU′PIONE. An ethereal liquid forming the chief portion of the light oil of wood-tar, and which also exists in the tar obtained during the destructive distillation of animal substances, and in the fluid product of the distillation of rape oil. It is separated from these substances by agitating them with oil of vitriol, or a mixture of oil of vitriol and nitre, and subsequent cautious distillation. Pure eupione is tasteless, exceedingly thin, limpid, and aromatic; boils at 47° C. (117° F.); and is the lightest liquid known; sp. gr. ·655. It is very inflammable, burns with a very bright flame, and gives a transient greasy stain to paper. It is isomeric with hydride of amyl. It is very stable, and is not decomposed by sulphuric acid, nitric acid, ptoassium, or potassium permanganate.

EUPYR′ION. Any contrivance for obtaining instantaneous light; as a lucifer match, &c.

EVAC′UANTS. *Syn.* Evacuantia, L. Medicines which augment the secretions or excretions. Cathartics, Diaphoretics, Diuretics, Emetics, Errhines, Expectorants, and Sialogogues belong to this class.

EVAPORATION. A term usually applied to the slow production of vapour at the free surface of a liquid; in *boiling*, the vapour is produced rapidly in the mass of the liquid itself. Another distinction between evaporation and ebullition is that the latter takes place at a definite temperature (provided the pressure is constant), while the former takes place over a very wide range of temperature; water evaporates even at the freezing-point, and ice is also transformed into vapour below the freezing-point, as shown by the drying of clothes in frosty weather. The formation of vapour seems, however, to cease at a certain point. Mercury, for example, does not evaporate appreciably below −10° C., nor sulphuric acid below 30° C.

The rapidity of evaporation of a liquid depends upon 4 causes:—(1) The temperature; (2) the quantity of the same vapour in the surrounding atmosphere; (3) the renewal of this atmosphere; (4) the extent of the surface of evaporation. The first cause is due to the increase of vapour-pressure with increase of temperature; the second and third to the fact that a given space will only contain a certain quantity of vapour under a given pressure. When the maximum quantity is attained, the vapour is said to be saturated. The influence of the fourth cause is self-evident.

Evaporation is chiefly made use of in the separation of volatile liquids from less volatile or non-volatile substances, as in concentrating a solution, separating liquids by fractional distillation, &c. The rate of evaporation is accelerated by increasing the area of the surface of the heated liquid, and wide, shallow vessels are therefore used for evaporating liquids. Evaporation takes place most rapidly when a current of air (especially hot and dry air) is made to pass over the surface of the liquid.

On the small scale, shallow capsules of glass, wedgwood-ware, porcelain, or metal, are commonly employed as evaporating vessels, and these are exposed to heat by placing them over a lamp or naked fire, or in a water-bath or sand-bath, according to the temperature at which it is proper to conduct the process. On the large scale, high-pressure steam is usually employed as the source of heat. The term 'spontaneous evaporation' is applied to the dissipation of a fluid by mere exposure in open vessels, at the common temperature of the atmosphere, and without the application of artificial heat. The rapidity of evaporation conducted in this manner wholly depends on the degree of humidity of the surrounding air, and differs from the former, in which rate of evaporation is proportionate to the degree of heat at which the process is conducted, and the amount of pressure upon the surface of the liquid. Evaporation '*in vacuo*' (as it is called) is conducted under the receiver of an air-pump, or in an attenuated atmosphere produced by filling a vessel with steam, so that the air is expelled,

all communication with the external atmosphere is then cut off, and the vapour condensed by the application of cold. Fluids are also evaporated in air-tight receivers over sulphuric acid, by which they are continually exposed to the action of a very dry atmosphere. When such a receiver is connected with an air-pump in action, evaporation proceeds with increased rapidity, and intense cold is produced. It appears from the experiments of Dr Ure that "if the bottom of a pan, and the portion of the sides immersed in a hot fluid medium (solution of chloride of calcium, for example), be corrugated so as to contain a double expanse of metallic surface, that pan will evaporate exactly double the quantity of water in a given time, which a like pan, with smooth bottom and sides, will do immersed equally deep in the same bath. If the corrugation contain three times the quantity of metallic surface, the evaporation will be threefold in the above circumstances. But if the pan, with the same corrugated bottom and sides, be set over a fire, or in an oblong flue, so that the current of flame may sweep along the corrugations, it will evaporate no more water from its interior than a smooth pan of like shape and dimensions placed alongside it in the same flue or over the same fire."

In the laboratory, steam heat is now almost exclusively employed. Copper pans, boilers, and stills are surrounded by a 'jacket' of cast iron, and high-pressure steam admitted between the two. By due management of the supply-cock, a range of temperature may be thus obtained extending from about 90° to 325° F.

It is found that, under ordinary circumstances, 10 square feet of heated surface will evaporate fully 1 lb. of water per minute; and that a thin copper tube exposing 10 feet of surface will condense about 3 lbs. of steam per minute, with a difference of temperature of about 90° F. This is equal to 30° F. per lb.; and consequently the heat of the steam employed to produce the evaporation should be $212° + 30° = 242°$ F.

An attention to the facts and principles thus briefly explained above will be found of great value in the laboratory.

EVERLASTING, CAPE (*Helichrysum vestitum*, Less.). The white silvery flower-heads are imported in large quantities to this country for decorative purposes.

Chaplets or immortelles are made of the flowers of the 'Yellow Everlasting' (*Helichrysum orientale*, Gaert.), commonly hung about tombs on the Continent. Other everlasting flowers used for decoration are *H. bracteatum*, Willd., *Helipterum roseum*, Bth., &c.

EXCIP'IENT. See PRESCRIPTION.

EXCI'TANTS. See STIMULANTS.

EXCORIA'TIONS. *Syn.* SPRAYS, CHAFINGS. In *surgery* and *pathology*, superficial injuries or affections of the skin, consisting of the removal of the scarf-skin or cuticle, accompanied with more or less irritation and slight inflammations. When arising from rough friction or attrition, they are more commonly called abrasions. Young children are very apt to be chafed under the arms, behind the ears, between the thighs, and in the wrinkles and folds of the skin generally, unless great attention is paid to cleanliness, and wiping the skin perfectly dry after washing them. Whenever there is a tendency to excoriations of this kind, either in adults or children, a little finely powdered starch, or violet powder, applied by means of a puff, or a small bag of muslin, once or twice a day will generally remove them, and prevent their occurrence in future. Mild unguents, as cold cream, or spermaceti cerate or ointment, may also be used with advantage. The preference should, however, be given to the remedies first named, from their not soiling the linen. Care should be taken, in washing children with tender skins, to use soap free from alkali. See ABRASION.

EXCRETA. See SEWAGE, URINE.

EX'ERCISE is essential to the healthy performance of the functions of both body and mind. Without it, the stomach acts feebly, the bowels become inactive, and the circulation of the blood languid and imperfect; the chest contracts, the respiration becomes impeded, the brain is insufficiently supplied with pure arterial blood, the mind grows lethargic, the complexion assumes a sickly and effeminate hue, and the features generally lack the energy and expression which they possess in perfect health. With exercise, the bodily functions are performed with vigour and regularity, the constitution is thereby strengthened, and the attacks of disease repelled. By exercise the mind too is excited to healthy action. It robs undue mental exertion of half its injurious effects upon the body, whilst it stimulates and directs it in its proper course. It improves the temper and humanises the character. The disposition is refined, the passions restrained, violent emotions checked, the habits improved, and the personal charms promoted under the stimulus of judicious exercise.

To females, bodily exercise is even more necessary than to males. The disposition and education of females are such as tend to produce habits of sloth and indolence to a greater degree than in the other sex. Hence to them exercise is doubly important—it is inseparable from health. The more retiring dispositions of females lead them almost unconsciously into habits of inactivity, which, above all, they should endeavour to shake off and avoid. By so doing—by replacing habits of indolence and inactivity by liveliness and moderate exercise—the development of the body will be promoted, additional grace and elegance imparted to its natural movements, and the enjoyments arising from both mental and bodily health increased, whilst disease and deformity will be prevented by the removal of their cause.

The necessity of exercise exists equally in every grade of society and age of life. Those who are engaged in sedentary employments or indoor occupations should particularly seek refreshing outdoor exercise during the periods of relaxation from their diurnal duties. To the studious and delicate of both sexes this is absolutely necessary to preserve the health and vigour of the body.

In infancy, exercise of a suitable kind should be almost the constant occupation of the little beings that claim our protection and care. It should, however, be always borne in mind that

the muscular exercise of very young children must be of the gentlest. Prejudice and ignorance frequently induce nurses and parents to teach their children to walk, as they falsely call it, and thus their feeble limbs are urged to make premature efforts to totter along before the bones and muscles have acquired sufficient strength to support the body in an erect position. From this course the legs and joints frequently become bent and misshapen, and severe injuries are often inflicted on the head and body by blows and falls. It should never be forgotten that crawling and rolling are their first modes of progression, and require the least exertion. Next comes the sitting posture; from this the child gradually advances to the erect one; then to walk by slight assistance; and, lastly, to walk safely alone. All this should come naturally, and never be promoted, further than by laying the infant on the carpet or floor, for the full exercise of its little strength. As soon as a healthy child is able to walk instead of crawl, its own disposition induces it to do so. The faculty of imitation, the spirit of enterprise, and the pride of doing what others do, present even in infancy, is rather apt to lead the infant to over-exertion than the contrary. The practice of constantly 'dolling' children in the arms is most prejudicial to the early development of their feeble powers.

It is injudicious to take an infant out during the hottest part of the day in summer; such a proceeding tends to enervate and depress rather than to strengthen him. Whenever he goes out his head should be protected from the direct rays of the sun by means of a large brimmed hat, made of cotton or straw, and an umbrella. The neglect of these precautions frequently gives rise to the disordered stomach, sickness, and diarrhœa, so prevalent during very hot weather. During other periods of the day, the weather being favourable and the locality healthy, an infant cannot be too much out of doors, especially during teething.

Infants of three or four months old may, under certain precautions, be sent out into the open air during the winter. They must be well wrapped up; they should be carried in the nurse's arms, and not consigned to a perambulator; they should never go out in foggy nor wet weather; if the wind be neither in the east nor the north-east there will be no objection to their being sent out on a clear frosty day. Spring is a trying period for infants and children, because of the prevalence of east winds; hence the necessity of seeing that they are well and warmly clad when sent out during this season. There is much less danger of a child taking cold during the autumn than the spring, as in autumn the winds frequently blow from the south, or warm quarter.

In childhood the exercise should be regulated according to constitution and age; avoiding inactivity on the one hand, and excessive exercise on the other. The outdoor plays and pastimes of BOYS will generally be found sufficient, and in some cases will even require to be curbed, to prevent fatigue and the overtaxing of the young frame. With girls it is frequently difficult to find sufficient exercise without trespassing on the prejudices of the ignorant, or the routine of their daily education. With them walking, and some healthy amusement, as skipping, hooping, or the like, should be indulged in for some hours daily. When this is impossible or inconvenient, they may be habituated to the practice of the more simple and cleanly portion of the domestic duties. In the performance of the latter the health will be promoted, whilst the care and attention which is always due by a female to herself and others, at all periods of her life, will become an easy acquisition, and assist the cultivation of the best feelings of her nature.

In youth exercise matures and promotes the development of the frame; and in manhood it is equally necessary, as already noticed, to keep it in healthy action. In age it will be found to assist the vital functions, and put off decay. In fact, to all—young, old, rich, and poor—physical exercise is essential to the permanent enjoyment of health.

From a medical point of view, "exercise, employed moderately, has a tonic and stimulating influence on the system, and is calculated to prove beneficial in a great variety of complaints. Used immoderately, it exhausts both the mental and bodily powers, and produces great debility" (*Pereira*). Well-directed exercise favours the preservation of the general health by calling into direct action the majority of the organs of the body; and it also acts powerfully on the skin by stimulating its functions, increasing its temperature, awakening its tone, and subjecting it to a current of atmosphere favourable to its respiratory offices. But, to be beneficial in the highest degree, exercise must be accompanied by feelings of present interest and enjoyment. The mind must direct and go with it; to ensure its full benefits, the 'soul must be present.'

"During convalescence, properly regulated exertion is highly serviceable; but it should never be carried so far as to produce exhaustion, and should be pursued for some time indoors before it be attempted in the open air; the latter, at first, should always take place in a carriage that can be opened or closed at will; the patient may then attempt short walks in the open air; but, in all cases, it is of importance that he is not unduly fatigued, as, otherwise, injury instead of benefit will be the result. One of the most serious errors committed with regard to exertion is that of permitting a convalescent to sit up too frequently or for too long a time, under the mistaken notion of giving him strength. A patient should never be allowed to sit up longer than is agreeable to his feelings, and never so long as to produce a sense of fatigue" (*Dr R. E. Griffith*).

THE PHYSIOLOGICAL EFFECTS OF EXERCISE. The accurate determination of the physiological effects of exercise has occupied the attention of physiologists for some years, and though the difficulties which beset the investigations on every side are such as to render the results difficult of interpretation, we are in possession of a mass of very valuable information on the subject, for which we are largely indebted to the Munich School of physiologists.

Inasmuch as exercise represents the conversion of the potential energy of our food into motion, no study of the effect of exercise upon the human

body can have any value which does not take into account the exchange of material and the modifications produced in it by muscular exertion. It has long been customary to compare the human body to a steam engine and the food to the fuel burnt under the boiler in order to generate the motive power, but in all except a very figurative sense the comparison is incorrect. The animal body is a far more perfect machine than the best known engine, but it is far more complicated, and carried into detail the comparison breaks down entirely. Even when the body is what we call at rest a vast amount of energy is being consumed in the processes of nutrition and repair and in the maintenance of life, and the activity of all these processes is enormously increased when we pass from a state of rest to a state of action. It thus becomes a matter of profound importance to the individual that the balance between his income of energy as represented by his food should not exceed the output as represented by external work. In the article ENERGY it has been pointed out that the experimentally calculated potential energy of the various food-stuffs was but a doubtful guide to the amount of external work possible on a given diet, and that the weight of evidence is in favour of the view that the energy required for the performance of external work is derived almost exclusively from the non-nitrogenous food-stuffs—that is to say, it is the fats, starches, and sugars in our food that enable us to walk and run and row, and not the albuminous articles of our diet, such as beef and mutton and eggs. That a large amount of work can be and is done upon a diet in which the albuminous food-stuffs greatly preponderate is a matter of every-day experience which would therefore appear to contradict the teachings of experimental physiology. The contradiction is more apparent than real, and though the question is still very far from being definitely settled—without entering into the detail which would be necessary in order to set out all that is known regarding the disposal of food by the human organism—the following general statement will suffice to give some idea of the direction in which physiological research is leading us: The investigations of Fick and Wislicenus, Parkes, and others, proved conclusively that a large amount of physical exertion can be sustained upon a diet composed exclusively, or almost exclusively, of fatty and starchy materials; and Frankland's investigations on the force-value of foods completed the proof by demonstrating that the total potential energy of the albuminous foods taken by the subjects of these experiments was less than the energy manifested as external work. As has been said, a very great amount of exertion can be sustained on an almost purely albuminous diet. This being an undoubted fact, we must seek an explanation in the complex structure of the albuminous molecule. On such a diet the nitrogen of the urine, which represents almost, within errors of experiment, the nitrogen of the digested food, will *not* account for the energy expended; we are therefore driven to assume, what we know by other evidence to be a fact, that the albuminous molecule may be so broken up in the body as to produce hydrocarbons, the oxidation of which yields the energy required. When the exercise is exceptionally severe and exhausting, the nitrogen eliminated by the urine tends to a slight excess over that taken in as food, and it has been shown by direct experiment that the human organism is capable of storing nitrogenous material to a certain extent, and this retention of nitrogen is especially observable during the period of rest immediately following on the exertion which caused the excessive elimination; nature apparently making an effort to bring up the reserve of nitrogen to the normal amount. Under ordinary circumstances, the income and output of nitrogen in a healthy individual on a regulated diet balance exactly; and by careful observation it has been found that if this nitrogen income and expenditure be studied over a considerable period divided into three equal parts, one of rest, one of work, and a third of rest again, the account will balance exactly. It has further been learned from these experiments that if several series of such observations be made consecutively, a relatively small amount of work, say 20 miles of sharp walking, will suffice to disturb the nitrogen balance on the first occasion, and that in each successive period of work the amount must be increased considerably in order to produce the same interference. If the experiments be continued, a stage is reached in which, using the same form of exercise, it is almost impossible to perform sufficient work in *one* day, allowing the same time for sleep and meals, to disturb the nitrogen balance at all. During this period the subject of the experiments is 'getting into training,' and so constant and certain are these results that we may define a state of perfect training as that in which the work required may be performed in the shortest possible time *without disturbing the balance* between the nitrogen of the ingesta and that of the excreta; and it may be regarded as equally certain that whenever this balance is disturbed to any appreciable extent, the individual in whose body it occurs has overtaxed his powers and should, by perfect rest and abundant food, assist nature to repair the damage.

In perfect health and during active exercise the temperature of the body rises considerably, and a state of temporary fever is induced which, however, subsides with great rapidity if the exertion be well within the powers of the individual. If, on the contrary, he has overtaxed his strength and drawn on his reserves, the febrile state will continue for a greater or less time according to the degree of excess of this exertion above the normal, *i. e.* until the damage be repaired. In case of extreme fatigue a true febrile state may be set up which may assume a serious form and require careful medical treatment.

The gravest symptom of over-exertion is sleeplessness and inability to take food. The man who, after severe fatigue and exposure, can eat a hearty meal and sleep profoundly has suffered no harm; whereas he who cannot do so should take the fact as an urgent warning not to repeat the experiment unless after careful training and trial. This constitutes *the* difference between the veteran and the young soldier. The older man whose growth is completed and who has learned by experience how to use his energies to the best advantage, is an economical machine; whereas the youth is

liable to waste his superabundant energy and to find himself in the hour of trial unable to meet the demands made upon his endurance. Novices in Alpine climbing are apt to complain of the slow pace of their guides, but they forget that when they are fatigued and exhausted it is to the guides they look for help. The fatigue-resisting powers of a healthy, well-trained man of 30 to 35 years of age, if he be careful how he expends them, are enormous, and no greater mistake can be made by a still growing lad than to despise the warnings of nature by exerting himself constantly to the limit of his powers; and, whilst athletic sports and exercises of all kinds should be encouraged in every way, a little care and common sense would prevent the production of the broken-down athlete to a very great extent. The rough work of Alpine climbing and travelling in new and unexplored districts is calculated to call forth some of the best qualities in man—endurance, courage, forethought, and coolness in danger; but such work should not be undertaken by those who are not sound in wind and limb and have proved themselves frequently by careful training. The hard test of experience serves to weed out a large number of the weak; but some remain with greater energy of will than power of body, and these are a source of great danger to their companions. A life of constant bodily activity on good plain food, and abstinence, or a practical abstinence, from alcohol, especially spirits, is one which dwellers in towns 'leading' sedentary lives can only regard with envy. Experience shows, however, that where brain work is in question the necessary exercise must be moderated and kept much within the worker's power, otherwise the sense of muscular strength and energy will interfere with the due exercise of the power of the mind and produce a disinclination for mental work. We may close this article with a word of advice as to the use of alcohol in exercise. There is overwhelming evidence that alcohol in all forms taken *during* exercise is bad, and that it distinctly diminishes the physical powers. A pedestrian with a forced march before him should take no alcohol whatever *during* the march; plain simple food, and that 'little and often,' should be his maxim. *When the work is done*, after due rest, he may eat a full meal and indulge in a glass of good ale or wine with advantage; and if excessively fatigued and threatened with sleeplessness, a proper amount of good alcohol may be the means of securing the much-desired and very necessary sleep.

Adopting the recumbent position as unity, Dr Edward Smith has given the following table, illustrating the quantities of air inhaled during various forms of exercise:

Lying position . . .	1·
Sitting	1·18
Standing	1·33
Singing	1·28
Walking 1 mile per hour .	1·90
" 2 " " . .	2·76
" 3 " " . .	3·22
" and carrying 34 lbs.	3·50
" " " 62 lbs.	3·84
" " " 118 lbs.	4·75
" 4 miles per hour .	5·
Walking 6 miles per hour .	7·
Riding and trotting . .	4·05
Swimming	4·33
Treadmill	5·50

Since a man takes into his lungs 480 cubic inches of air per minute, in walking four miles an hour he draws in 2400 cubic inches, and if six miles 3260 cubic inches a minute (*Parkes*).

Dr Smith estimated the amount of carbonic anhydride evolved under differing conditions, and found that—

	Carbonic acid exhaled per minute in grs.
During sleep	4·99
Lying down, and almost asleep (average of three observations)	5·91
Walking at the rate of 2 miles an hour	18·10
Walking at the rate of 3 miles an hour	25·83
Working at the treadmill, ascending at the rate of 26·65 feet per minute (average of three observations) . .	44·97

The relative amounts of carbonic anhydride eliminated from the lungs during periods of rest and exercise have also been investigated by Pettenkofer and Voit. The following table, which gives the results of their experiments, also records the quantities of oxygen absorbed, and of water and urea excreted at the same time:

	Absorption of Oxygen in Grammes.	Elimination in Grammes of—		
		Carbonic Acid.	Water.	Urea.
Rest-day . . .	708·9	911·5	828·0	37·2
Work-day . . .	954·5	1284·2	2042·1	37·0
Excess on work-day (with exception of urea)	246·6	372·7	1214·1	0·2

If the quantities in the above table be converted into ounces it will be found that nearly 8¾ oz. more oxygen were absorbed and 13 oz. more of carbonic anhydride eliminated by the lungs during a work-day than during a rest-day (*Parkes*). It must be stated that during the work-day an interval of rest was taken, and that the labour was by no means excessive.

The Rev Professor Haughton, in his work entitled 'A New Theory of Manual Labour,' has drawn up a table (which we append), of the amount of force expended during various kinds of work. It represents the number of tons lifted one foot per diem.

Professor Haughton has devised a formula by means of which a certain amount of walking exercise may be made to represent its equivalent in manual labour. He points out that walking on a level surface is equivalent to raising 1-20th part of the weight of the body through the distance walked.

Labouring Force of Man.

Kind of Work.	Amount of Work.	Authority.
Pile-driving	312 tons lifted 1 foot	Coulomb.
Pile-driving	352 ,, ,,	Lamande.
Turning a winch	374 ,, ,,	Coulomb.
Porters carrying goods, and returning unladen . . .	325 ,, ,,	,,
Pedlars always loaded	303 ,, ,,	,,
Porters carrying wood up a stair, and returning unloaded .	381 ,, ,,	,,
Paviours at work	352 ,, ,,	Haughton.
Military prisoners at shot-drill (3 hours), and oakum-picking and drill	310 ,, ,,	,,
Shot-drill alone (3 hours)	160·7 ,, ,,	,,

When ascending any height, the whole weight of the body is, of course, raised through the ascent. The formula is—

$$\frac{(W + W') \times D}{20 \times 2240};$$

where W is the weight of the person, W the weight carried (if any); D the distance walked in feet; 20 the co-efficient of traction; and 2240 the number of pounds in a ton. The result is the number of tons raised 1 foot. To get the distance in feet 5280 must be multiplied by the number of miles walked.

Supposing a man to weigh 150 lbs. with his clothes, by the employment of the above formula we should arrive at the following results:

Kind of Exercise.	Work done in tons lifted 1 foot.
Walking 1 mile	17·67
,, 2 ,, ...	35·34
,, 10 ,, ...	176·7
,, 20 ,, ...	353·4
,, 1 ,, and carrying 60 lbs.	24·75
,, 2 ,, ,, ,,	49·5
,, 10 ,, ,, ,,	247·5
,, 20 ,, ,, ,,	495

From the above data something like a rough approximation may be formed of the daily amount of exercise requisite for a healthy male adult.

Since 500 tons lifted 1 foot is extremely hard work, the number of miles corresponding to this extreme amount of labour would, if persevered in, be objectionable.

Dr Parkes, regarding 300 tons lifted 1 foot as an average day's work for a healthy man, thinks that walking exercise equivalent to half that amount should be taken daily. This, or 150 tons, represents a 9 miles' walk. He, however, qualifies the suggestion by adding "that, as there is much exertion taken in the ordinary business of life, this amount may be in many cases reduced;" and concludes by saying, "It is not possible to lay down rules to meet all cases, but probably every man with the above facts before him could fix the amount necessary for himself with tolerable accuracy."

EXPANSION. All substances, solid, liquid, and gaseous, when chemical change does not take place, expand when heated, and contract when cooled. The amount of expansion is different in different substances, but is always the same for the same substance under the same conditions.

Expansion of Solids. We may consider the expansion in one dimension, the *linear* expansion; in two dimensions, or the *superficial* expansion; or in three dimensions, the *cubical* expansion, or expansion of volume. The *co-efficient of linear expansion* of a solid is the elongation of unit length of the solid when its temperature rises from 0° to 1° C., the *co-efficient of superficial expansion* is the increase of the surface of unit area of the solid, and the *co-efficient of cubical expansion* is the increase of volume of unit volume of the solid when its temperature rises from 0° to 1° C. The co-efficient of superficial expansion is twice, and of cubical expansion three times that of linear expansion of a substance.

The co-efficient of linear expansion of a substance may be determined by measuring the length of a rod of the substance at different temperatures, say 0° and 100° C. This may be done in several different ways, for descriptions of which text-books on physics must be consulted.

Co-efficients of linear expansion for 1° between 0° and 100° C.

Sulphur .	·00006413	Copper . .	·00001718
Zinc . . .	·00002944	Gold . .	·00001466
Lead . .	·00002857	Wrought iron	·00001220
Tin . . .	·00002173	Cast iron .	·00001125
Silver . .	·00001910	Platinum .	·00000884
Brass . .	·00001878	White glass	·00000861

Practical Applications of the Expansion of Solids. Tires are secured on wheels by placing them in position when red hot, so that on cooling they contract with great force upon the wheels. Whenever iron bars are used in constructing buildings, bridges, &c., allowance must be made for the expansion and contraction of the metal, in order to prevent any displacement of the construction.

Compensation pendulums are made with rods of different metals, with different co-efficients of expansion, so arranged that they expand in opposite directions, and maintain a constant distance between the centres of suspension and oscillation. The same principle is also applied to the compensating balance-wheels of chronometers.

Expansion of Liquids. As a liquid must be contained in some vessel, the 'apparent expan-

sion' of a liquid when heated through a certain number of degrees is the expansion of the liquid *minus* that of the containing vessel. If the amount of expansion of the vessel is added to the 'apparent expansion' of the liquid, we get the real or 'absolute expansion' of the liquid. The co-efficient of absolute expansion of mercury has been determined by Dulong and Petit by means of a U-shaped tube containing mercury, one limb being kept at 0° C. by melting ice, and the other limb being heated in an oil-bath; the height of mercury column in each limb was read, and the co-efficient calculated from the results. Knowing the real expansion of mercury, and the apparent expansion of mercury in a glass vessel, we can calculate the expansion of the glass vessel and the co-efficient of cubical expansion of glass.

The co-efficient of absolute expansion of mercury is used in reducing barometric readings to 0° C., which is done in order to make the indications comparable at different times and in different places. When water is cooled it contracts till its temperature reaches 4° C., and then begins to expand again; the temperature 4° C. is therefore called the *point of maximum density* of water. This is a very remarkable property of water, and has an immense influence upon natural phenomena; without this property, a body of water would freeze to one mass of ice instead of becoming coated with ice on its surface. The water a little below the ice never reaches a temperature below 4°, for when it has been cooled to this temperature it begins to expand, and forms the top layer of the water under the ice. Fishes are thus never frozen to death, so long as any water remains.

Liquids expand with enormous force, the force being equal to that which would be required to bring back the liquid to its original volume.

Density of Water between 0° *and* 30° C.

Temperatures.	Densities.	Temperatures.	Densities.
0	·99988	16	·99900
1	·99993	17	·99884
2	·99997	18	·99866
3	·99999	19	·99847
4	1·00000	20	·99827
5	·99999	21	·99806
6	·99997	22	·99785
7	·99994	23	·99762
8	·99988	24	·99738
9	·99982	25	·99704
10	·99974	26	·99089
11	·99965	27	·99662
12	·99955	28	·99635
13	·99943	29	·99607
14	·99930	30	·99579
15	·99915		

Expansion of Gases.—All gases expand equally for a given rise of temperature, *i.e.* they have the same co-efficient of expansion, viz. $\frac{1}{273}$, or ·003667; 273 vols. at 0° C. become 274 vols. at 1°, 275 at 2°, and so on. The co-efficient was found by Regnault by several methods. The air thermometer depends on the expansion of air; it consists either of a globe containing air, with a narrow stem, and a drop of liquid as an index, or of a bulb containing air which is sealed at the temperature to be determined, and opened under mercury.

Everyone is familiar with the fact that hot air ascends, and thus heated rooms become much hotter near the ceiling than near the floor; this is due to the expansion of the air by heat, which renders it specifically lighter.

EXPEC'TORANTS. *Syn.* Expectorantia, L. Medicines that promote the secretion of the tracheal and bronchial mucus. According to Dr Good, true expectorants are "those medicines which rather promote the separation of the viscid phlegm with which the bronchi are loaded than simply inviscate and dilute it; though these are also treated as expectorants by many writers." Ammoniacum, antimonials, assafœtida, the balsams of Peru and tolu, benzoic acid, benzoin; the fumes of vinegar, tar, and several of the volatile oils; garlic, ipecacuanha, the oleo-resins, squills, tartarised antimony, and the smoke of tobacco and stramonium are among the principal substances commonly called expectorants. Tartarised antimony, squills, chlorine, and ammoniacal gases, have also been used (diluted) to provoke the coughing and favour the expulsion of foreign bodies from the air-passages; and also to favour the expectoration of mucus, pus, and membranous concretions, when the local irritation is not sufficiently great (*Schwilgue*). Expectorants are commonly employed in pulmonary complaints and affections of the air-tubes, attended by a vitiated state of the mucus, or an imperfect performance of the natural functions of the secretory vessels. "Of all classes of the materia medica, none are more uncertain in their action than expectorants" (*Pereira*). The act of ejecting matter from the chest is called Expectoration.

EXPER'IMENTS are acts or operations intended to develop some unknown fact, principle, or effect; or to establish or demonstrate it when discovered. Similar operations, performed merely for amusement, are also often, though incorrectly, called by this name. To experimental research is due the present high state of advancement and usefulness of the various arts and sciences. The danger of taking things for granted has been thus pleasantly and instructively pointed out by Archbishop Whately: "It was objected to the system of Copernicus, when first brought forward, that if the earth turned on its axis, as he represented, a stone dropped from the summit of a tower would not fall at the foot of it, but at a great distance to the west; in the same manner as a stone dropped from the masthead of a ship in full sail does not fall at the foot of the mast but towards the stern. To this it was answered, that a stone, being a part of the earth, obeys the same laws, and moves with it; whereas it is no part of the ship, of which, consequently, its motion is independent. The solution was admitted by some, but opposed by others; and the controversy went on with spirit; nor was it till 100 years after the death of Copernicus that, the experiment being tried, it was ascertained that the stone, thus dropped from the head of the mast, *does* fall at the foot of it."

EXPRES'SION. In the *useful arts*, the mechanical operation by which a fluid contained in

the pores or cells of a solid is pressed out or expelled. Many of the fluid substances employed in *pharmacy* and *chemistry* are obtained by expression. Thus, the unctuous vegetable oils, as those of almonds, linseed, &c., are procured by submitting these substances to powerful pressure between iron plates, which are either made warm, or the bruised seeds are previously exposed in bags to the steam of boiling water. The juices of fresh vegetables are also obtained by expression. The substances are first bruised in a marble mortar, or, on the large scale, in a mill, and immediately submitted to the press, to prevent them passing into a state of fermentation, which would injure the quality of the product. Fruits which contain highly flavoured or fragrant seeds, or which have rinds containing essential oil, are generally deprived of them before being sent to the press. The subacid fruits are also allowed to lie together for some days before pressing them, as the quantity and quality of the product is thereby increased. The fluid matter absorbed by the ingredients employed in the preparation of tinctures, infusions, decoctions, extracts, &c., is generally obtained by powerful pressure. Expression is also frequently had recourse to for the purpose of obtaining solids in a state of purity, as in the expulsion of olein from stearin, water from bicarbonate of soda, &c. On the small scale, the common screw-press, or one of like construction, is usually employed; but the power thus obtained is insufficient to expel the whole of a fluid diffused through the pores of a solid. Hence has arisen the use of the hydraulic press, which is now almost alone employed on the large scale. In all these cases the substances are placed in bags made of haircloth or coarse canvas, previously to their being submitted to pressure. For tinctures and like pharmaceuticals, a small screw-press (TINCTURE PRESS) made of 'galvanised' or tinned iron, and varying in capacity from 1 quart to several gallons, is employed.

EXSICCA'TION. See DESICCATION.

EXT'RACT. *Syn.* EXTRACTUM, L. Among chemists this term is understood to apply to the residuum of the evaporation of aqueous decoctions or infusions of vegetable matter. In *medicine* and *pharmacy*, it has a less definite signification, being applied to various preparations obtained by evaporating the expressed juices, or the decoctions, infusions, or tinctures, of vegetable substances, until a mass of a solid, semi-solid, or fluid consistence is formed. Extracts vary in their nature and composition with the substances from which they are prepared and the fluids employed as solvents. When water is employed as the menstruum, the products (AQUEOUS EXTRACTS, WATERY E.; EXTRACTA AQUOSA, E. SIMPLICIORA, L.) usually consist of gum, starch, sugar, albumen, extractive and saline and other matter, along with the peculiar principles on which the medicinal virtue of the vegetable depends. When spirit is employed as the solvent, the products (ALCOHOLIC EXTRACTS; EXTRACTA ALCOHOLICA, L.) contain most of the substances above enumerated, except the gum and starch, together with several other substances which are soluble in spirit, but which are either wholly or nearly insoluble in water; as resins, essential oils, and the proximate principles of vegetables. These preparations, with scarcely an exception, are considerably more powerful than the aqueous extracts of the same vegetables. In some cases proof spirit or under-proof spirit is employed, when the extracts (SPIRITUOUS EXTRACTS; EXTRACTA SPIRITUOSA, L.) generally possess properties between those of the above. In other cases, dilute acetic acid or acidulated water is employed as the menstruum, when the products (ACETIC EXTRACTS; EXTRACTA ACETICA, L.) possess much greater activity than when prepared with water, and would in many cases prove fatal if exhibited in doses as large as those of the aqueous extracts. Still more active extracts are obtained by a combination of the last two menstrua. According to Ferrari, plants treated with rectified spirit of wine mixed with 1-36th part of acetic acid yield extracts of remarkable activity. On the Continent ether is sometimes used as the menstruum for the active principles of certain substances, as cantharides, cubebs, worm-seed, &c. (ETHEREAL EXTRACTS; EXTRACTA ETHEREA, L.). The term 'simple extract' is applied to an extract prepared from a single plant or vegetable substance, and the term 'compound extract' to one prepared from two or more of such substances. The FLUID EXTRACTS (EXTRACTA FLUIDA, L.) of modern pharmacy are those which are only evaporated to the consistence of a thin syrup, and then mixed with 1-10th to 1-8th of their volume of rectified spirit.

Prep. The preparation of medicinal extracts may be conveniently considered under two divisions, viz.: 1, the production of a solution of the soluble portion of the substances operated on; and 2, the reduction of this solution by evaporation to the consistence of an extract.

1. PREPARATION OF SOLUTIONS. The preliminary operations in the manufacture of extracts are similar to those employed in the preparation of DECOCTIONS, INFUSIONS, and TINCTURES. The proper quantity of the ingredients being taken, the whole is well bruised or reduced to powder of 20, 40, or 60 degrees of fineness, or otherwise divided by slicing with a knife, that every portion may be fully exposed to the solvent action of the fluid. In some few cases (as with gentian, &c.) the 'slicing,' or reduction to fragments, is often conveniently deferred until the action of the menstruum shall have so far softened the ingredients as to render them of easy division by the knife. Those substances (as sarsaparilla, chamomiles, &c.) whose medicinal principles reside in the cortical portion, and which are of easy solubility, are commonly subjected to the action of the menstruum without being subjected to any particular preparation.

In the preparation of AQUEOUS EXTRACTS the ingredients are treated with water until all the soluble matter that it is desirable to obtain is dissolved out. There are several methods of effecting this object, depending upon the nature of the substances acted on. In some cases maceration in cold water is resorted to; in others percolation with that fluid in a 'displacement apparatus. More generally, however, boiling water is poured on the substance, and is digested on it for some

time, as in the preparation of infusions; or the substance is exhausted by boiling in water, as in the preparation of decoctions. After the ebullition or infusion has continued a sufficient time, the heat is removed, and the liquid portion drawn off. The ingredients are then pressed to extract the remaining liquid; or they are washed or 'sparged' with hot water, which expels it by displacement. According to the usual practice in the majority of cases, a second quantity of water is poured on after the first has been thoroughly drained off, and the infusion or decoction is repeated a second and even a third time, or until the ingredients are perfectly exhausted of their soluble portion. The liquor or liquors thus obtained being allowed to repose for 15 or 20 minutes, for the purpose of depositing the sand or other gritty and heavy matter that is mechanically mixed with them, are carefully decanted from the sediment, and, after being run through a fine hair-sieve or flannel bag, are ready for concentration. In some instances, however, this method proves insufficient to render the liquid clear. In such cases the solution may generally be rendered transparent by clarification with a little white of egg, removing the scum as it rises, straining the liquid through flannel, as before; or the liquid may be filtered through a bag made of fine 'Welsh flannel,' or of 'tweeled cotton cloth' (Canton flannel), both of which should be soaked in clean water for at least an hour before use. In the small way, filters of linen or paper are sometimes employed; but as all media sufficiently fine to render vegetable solutions transparent soon choke up, this filtration is objectionable from the length of time it occupies. In some houses the aqueous infusion or decoction is allowed to repose for 24 hours, and then decanted and evaporated; but such a plan is objectionable, as, however smooth and glossy extracts so prepared may appear, their medicinal virtues are lessened by the lengthened exposure to the atmosphere.

When about one half of an aqueous solution has evaporated, it is often advantageous to repass it through a flannel or horsehair strainer, to remove the flocculi that generally form by the action of the heat and air. This is especially necessary with vegetable solutions prepared without boiling, and should be adopted whenever a smooth and sightly extract is desired.

2. Reduction of Solutions. The reduction of the solution to the proper consistence is effected by evaporation. The mode in which this is performed varies for different extracts. The London College directs that, "unless otherwise ordered, the evaporation should be conducted as quickly as possible, in a broad, shallow pan, placed in a water-bath, until a proper consistence is acquired for forming pills; stirring assiduously with a spatula towards the end of the operation." The Dublin College orders that "all simple (aqueous) extracts (extracta simpliciora), unless otherwise ordered, are to be prepared by boiling the vegetable matter in 8 times its weight of water, till the liquid is reduced to one half; the liquor is then to be expressed, and, after a short time allowed for defæcation, to be decanted, filtered, and evaporated in a steam or water bath, until it begins to thicken, and then finally inspissated by a reduced heat, with continual stirring, until a consistence for forming pills be attained." The instructions of the Edinburgh College are similar, with the one important exception, however, of ordering the evaporation to be conducted in a water-bath saturated with chloride of sodium.

Though the water-bath has the sanction of the London College, it is ill adapted for the purpose to which it is here ordered to be applied, as from its low evaporative power the advantages which are derived from its equable temperature are vastly overbalanced by the lengthened exposure of the solution in a heated state to the action of the atmosphere. It has been shown that a vegetable extract so prepared is inferior in quality to a similar one formed by rapid evaporation in a shallow pan over a naked fire, or placed in a sand-bath, provided proper care be taken, and assiduous stirring adopted during the whole time of the exposure to heat. In practice, however, the use of a naked fire is perfectly inadmissible, as the least neglect on the part of the operator would probably lead to the incineration of the whole. These objections are obviated by the addition of the 1-5th part of salt to the water of the bath, which raises its boiling-point to 218¾° F., when the temperature of the contained extract is fully 212°; the remaining 6° being lost by the interposition of the substance of the evaporating vessel.

On the large scale, the evaporation of infusions or decoctions for extracts is usually conducted in very wide, shallow, copper or tinned-copper pans, having steam-tight jackets of cast iron, and heated by steam 'playing' between the two.

The rapid deterioration which vegetable juices and solutions undergo by exposure to the air, especially at high temperatures, has led to the introduction of apparatus by which they may be concentrated without contact with the atmosphere, and at a less degree of heat than is required for that purpose in open vessels. Such is the method, commonly called 'Barry's process,' in which the air is removed from certain air-tight refrigerators by the introduction of steam, which is then condensed by the application of cold, by which means a partial vacuum is obtained. Another process for attenuating the atmosphere over the surface of fluids during evaporation is by the action of an air-pump. This plan was introduced by Howard, and is commonly applied to the concentration of syrups in the sugar refineries. Extracts obtained by either of these methods are said to be prepared *in vacuo*, and are found in practice to be immensely superior to the common extracts of the shops, and consequently require to be exhibited in proportionably small doses.

'The American Journal of Pharmacy' for September, 1877, contains a new process for the preparation of extracts without heat, by Professor Herrara. We extract the following from the Professor's paper:

"The results of my observations have satisfied me that, when the water partially congeals, the dissolved principles remain in solution in the mother-liquors, and that 2 or 3 congelations are generally sufficient for obtaining the solutions concentrated enough to finish the extract by ex-

posure upon plates to the heat of the sun, or of a drying closet heated to about 30° C. (86° F.). The extracts prepared by this method accurately represent the properties of the plants, and the principles which are changed by the influence of heat remain unaltered; even the volatile constituents are not dissipated, though most of the water be removed by freezing. Owing to the small cost of the necessary apparatus, it appears to me that my process for preparing extracts should be preferable even in those countries where ice is less readily obtainable than combustibles.

"Extract of conium prepared with unpurified juice by the process mentioned, has preserved the characteristic odour of conia, and, by dissolving it in water, I have obtained a solution exactly representing the juice of the plant in appearance and properties, and giving when heated an abundant coagulation, proving that even albumen had remained unaltered. 1750 grms. of cow's milk at 9° R. left, after 3 congelations, 750 grms. of a liquid having a density of 148, and by evaporation in the sun this left a dry extract of milk, which again formed that liquid on being dissolved in water. A number of other liquids similarly treated gave corresponding results, and it seems to me, therefore, that medicinal extracts are best prepared by congelation. It may be objected that the medical juices should be previously purified, but it should be remembered that coagulated albumen always encloses a considerable portion of the active principles, and that the heat necessary to effect the coagulation and the evaporation by means of a water-bath is sufficient to change many principles; also that the extracts thus prepared are sometimes inert or less active. The careful experiments made by Orfila and the clinical experience of others demonstrate that extracts prepared with unpurified juice are stronger.

"The apparatus employed by me is the so-called *sorbetière* (an apparatus similar to that used for ice-cream); for larger quantities the apparatus of Gougaud is preferable. The frigorific mixture is composed of ice and sodium chloride, or preferably of crystallised calcium chloride. After a large portion of the solution has congealed, the mass is enclosed in a cloth and subjected to pressure, the press-cake of ice is broken and again pressed, to separate the mother-liquor as completely as possible, and the congelation is repeated 2 or 3 times, with the precaution that it is not carried far enough to cause the precipitation of the sparingly soluble principles. The mother-liquor is then put into shallow dishes and exposed to the heat of the sun or of a drying room, the temperature of which does not exceed 30° C. (86° F.), until the extract has attained the desired consistence."

Obs. When water, acidulated with acetic acid, is employed in the preparation of extracts, the vegetable substances are usually macerated in it in the cold, or the dilute acid is sprinkled over the bruised plant in the fresh or recent state, and the whole is then submitted to strong pressure, to expel the juice, which is strained and evaporated in the usual way, but preferably in a well-tinned or plated copper pan.

ALCOHOLIC and SPIRITUOUS EXTRACTS are prepared by evaporating a filtered concentrated tincture of the ingredients in any suitable vessel, by which the volatilised spirit may be saved. In general, rectified spirit is used as the menstruum; but in some cases proof spirit is employed; and, in others, the substances are first digested in proof spirit, and afterwards in water, and the mixed tincture and infusion evaporated in the usual manner.

ETHEREAL EXTRACTS are obtained in a similar manner to alcoholic ones; but, being merely prepared in small quantities at a time, the process may be conveniently performed in glass vessels. When it is required to boil either of the above fluids (alcoholic or ethereal), or any other volatile liquid on the ingredients, a vessel fitted with a long tube, or a Liebig's condenser reversed, as noticed under ETHER, may be used to prevent any loss of the menstruum.

The INSPISSATED VEGETABLE JUICES (JUICES, E.; SUCCI, L.) of the British Pharmacopœia are obtained by expressing the juices from the fresh plants, and preserving them by the addition of spirit. "By thus preserving the juice of the plant its properties are not impaired by the action of the air during the time necessary to dry the leaf for tincture, nor by the action of both air and heat during the time necessary to evaporate the juice to the consistence of an extract" (*Squire*). The directions of the Edinburgh College for preparing their inspissated juices (SUCCI SPISSATI, L.) are: "Beat the fresh substance, and press it strongly through a canvas bag, in order to obtain the juice; which, being put into a wide, shallow vessel, and heated by means of boiling water saturated with sea-salt, is to be reduced to the consistence of honey. The mass, when cold, is to be put into glazed earthen vessels, and moistened with strong alcohol." By operating in this way a considerable portion of the activity of narcotic vegetables is lost. Some of their juices, as that of aconite, are impaired in so short a time as scarcely to compensate for the trouble of preparing them. This deterioration does not, however, take place in any remarkable degree if the expressed juice from the recent vegetable be evaporated by exposing it in a thin stratum to a current of very dry air, as adopted by Mr Squire. This may be managed by putting the juice into small flat trays or dishes, placed on shelves in a suitably arranged apparatus, alternated with similar vessels of concentrated sulphuric acid; or by causing a current of very dry air, at the common temperature of the atmosphere, to pass over them. It has been shown that 10 gr. of extract thus prepared were more than equal to 20 gr. prepared *in vacuo*, and to more than 60 gr. and in some cases 90 gr. of those prepared by the common process of boiling down the juice to an extract.

Aqueous extracts, as a rule, are only partly soluble in water; this is due to the influence of high temperature and exposure to air during the process of evaporation. Many active principles are thus modified or decomposed, their action becoming changed and unreliable. Such is especially the case with aloes; hence the B. P. orders extract of aloes to be made by evaporation in a current of warm air. In vacuum-made extracts the above objection is reduced to a minimum.

The concluding portion of the process of

extract-making, technically termed 'finishing-off,' requires the most scrupulous attention. As the evaporation advances the heat should be lessened, and as soon as the extract acquires the consistence of thick treacle it should be removed altogether, and the remainder of fluid matter evaporated by the heat retained by the copper pan, the escape of vapour being promoted by assiduous and laborious stirring with a suitably shaped wooden spatula. This part of the process should be continued until a proper consistence is attained and the extract is nearly cold. When high-pressure steam or a chloride of calcium bath is employed, care must be taken to withdraw the heat before stirring the semi-liquid mass; as, if an extract having a temperature of about the boiling-point of water, or even a few degrees below it, is agitated, it becomes full of bubbles, and appears rough and puffy, and this appearance cannot be removed by subsequent stirring or by any method but redissolving it in water and re-evaporation. This is especially the case with the extracts of sarsaparilla (simple and compound), gentian, liquorice, and most others of a similar class. A good laboratory man knows from experience the proper time for the removal of the heat, but unpractised persons often fail in this particular. In such cases, should the heat retained by the evaporating pan and by the extract prove insufficient to complete the process, a little more may be cautiously applied. Without assiduous and laborious stirring in the way described a very smooth and glossy extract cannot be produced. To promote this artificial appearance, some persons add 3% or 4% each of olive oil and gum-arabic, dissolved in water, with about 1% or 2% of spirit of wine.

The consistence of the ordinary extracts of the shops is the same as that of electuaries and confections, and is described in the Ph. E. as equal to that of 'thick honey.' The instructions of the Ph. L. and D., to evaporate the mass "until it acquires a consistence proper for making pills," except in two or three cases (as ext. colocynth. comp., &c.), are not adopted, and, indeed, would be found inconvenient in practice. Extracts evaporated to such a consistence are commonly termed 'pilular extracts;' and when evaporated so that they are quite dry, and brittle when cold, they are called 'hard extracts' (EXTRACTA DURA, L.).

Pres. Extracts should be put into pots as soon as taken from the pan, and, after being carefully and securely tied over with bladder, should be 'stored' in a dry situation. The London College orders "a small quantity of rectified spirit to be sprinkled upon all the softer extracts to prevent them becoming mouldy." A better way is to employ a little spirit, holding in solution a few drops of oil of cloves. This should be added to them the last thing before removing them from the evaporating pan, and when they are nearly cold. The same object is effected by moistening the inside of the bladder (used to tie them over) with a few drops of oil of cloves. Hard extracts should be kept in bladders or gut skins, placed in stone pots, and well covered over. With care, extracts prepared from recent vegetable substances may be preserved twelve months, or from season to season; and those from dry ingredients, or such as are less inclined to spoil, for perhaps double that time; but beyond these periods their virtues cannot be relied on, and they should consequently be discarded if remaining unused or unsold.

Pur., &c. The quality of an extract cannot be ascertained by mere inspection, nor is it readily discovered by chemical tests. A knowledge of these facts has induced the mercenary and fraudulent manufacturer to employ damaged and inferior drugs in their preparation, alike regardless of the welfare of the patient and the credit of the practitioner. A common practice with some manufacturers is, not only to pick out the least expensive variety of every drug for the preparation of their extracts, but the most inferior and often damaged and worthless portion of this already inferior article. The production of a smooth, bright, and glossy extract is all that is usually attempted by these individuals, and all that is sought after by the mass of purchasers, who mistake the simulation of the mere external signs of good quality for its actual existence. It is a fact, which we can verify from extensive experience in the laboratory, and from years of practical observation on this point, that extracts faithfully prepared from good materials do not possess the sightly and pleasing appearance of those commonly vended by the wholesale druggists. On comparing the extracts prepared by different metropolitan houses, we have found that those which have exhibited a remarkably bright and glossy appearance have been uniformly inferior, and sometimes nearly inert; whilst others, with a less prepossessing appearance, have been generally of good quality. These facts are well established by reference to the extracts of those houses and institutions that are remarkable for the superior quality of their preparations, and by comparing them with the common extracts of the shops supplied by the wholesale trade.

A good extract should be: 1. Free from grit, and wholly soluble in 20 parts of the menstruum employed in its preparation, forming a nearly clear solution. 2. It should have a uniform texture and colour, and be of a proper consistence. 3. If a narcotic or active extract, it may be exhibited in proper doses, and its effects watched. Its activity may also be tested on any small animal. 4. An assay for the proximate vegetable principle (alkaloid, &c.) contained in the plant from which it has been prepared may be made. The extracts prepared from the expressed juices of plants, without straining off the coagulated albumen, are, of course, exceptions to the first test. Unfortunately, these tests are not always easily performed, and the last two are inapplicable to those extracts that exercise no very marked physiological action, unless when taken in repeated doses, long continued. This want of a ready means of accurately testing the qualities of extracts has enabled the fraudulent manufacturer to sell inferior articles with impunity, and often without the least fear or danger of detection.

In general, an extract more than 6 months old contains only half the activity of a similar one newly made. When more than 12 months old they should be rejected as worthless, and the stock renewed.

Uses, &c. The extracts of the shops are generally acknowledged to be the most varying, imperfect, and uncertain class of medicines belonging to modern pharmacy. They are mostly used in the same cases as the plants from which they are prepared, but in smaller doses.

Concluding Remarks. In the preparation of extracts the great desiderata to be aimed at are—to suit the menstrua and the methods of manipulating to the peculiar characteristics of the active constituents of the vegetable substances operated on. The pharmaceutist should always bear in mind that a perfect extract should be a concentrated, solid mass, representing as near as possible, in medicinal efficacy, the materials from which it has been prepared, and capable of being redissolved, so as to form a solution closely resembling that from which it has been derived. An extract possessing equal strength to the whole mass of the ingredients from which it has been prepared is almost next to an impossibility, however desirable such a degree of perfection may be. The medicinal properties of all solutions of vegetable matter are injured by being reduced to the solid state; and this deterioration, more or less, takes place whether the solvent be water, acetic acid, proof spirit, or alcohol. The volatile portions (the essential oils, the aroma, &c.) are nearly or wholly dissipated; and though these do not always form the principal or active ingredients of the vegetables from which extracts are prepared, yet they generally exercise a modifying and controlling influence over the other ingredients, which considerably alters their therapeutical action. The loss of aroma may often be a trifling deficiency, but in the extracts of aconite, henbane, hemlock, belladonna, and other narcotic plants, this is not the case. In these cases it is well known that the inert preparations are wholly deficient of the odour of the recent plant, and that in proportion as the odour is developed, so is their activity preserved. The powerful smell of the recently expressed juice of hemlock, with the scarcely perceptible odour of the extract (EXTRACTUM CONII, Ph. L.), offers an excellent example of this fact. The dose of the one often reaches 20 or 30 gr., whilst that of the other seldom exceeds 5 or 10 drops, or a portion equivalent in dry ingredients to considerably less than ½ gr.

When extracts are ordered in prescriptions, those of the 'Pharmacopœia' should be alone employed by the dispenser, as the substitution of others for them would not only be violating faith with the prescriber, but might also produce consequences alike injurious to the dispenser and the patient. Many medical gentlemen prefer extracts prepared by particular processes or persons, but such intention is always indicated in their prescriptions.

Extract of Ac′onite. *Syn.* EXTRACT OF WOLFSBANE, E. OF MONKSHOOD, INSPISSATED JUICE OF ACONITE; EXTRACTUM ACONITI (B. P., Ph. L. E. and U. S.), SUCCUS SPISSATUS ACONITI (Ph. D. 1826), L. *Prep.* 1. (B. P.) Take 112 lbs. of the fresh leaves and flowering tops, bruise them, press out the juice, heat it gradually to 130° F., and separate the green matter by a calico filter. Heat the strained liquor to 200° F. to coagulate albumen, and again filter. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; then add to it the green colouring matter previously separated, and stirring the whole together assiduously, evaporate at a temperature not exceeding 140° F. to a pill consistence.—*Dose,* 1 to 2 gr.

2. (Ph. L.) Take of fresh leaves of aconite, 1 lb.; bruise them in a stone mortar, express the juice, and evaporate it, unstrained, to a proper consistence. The formulæ of the Ph. D. and U. S. are similar.

3. (Ph. E.) Beat the fresh leaves of aconite to a pulp, and express the juice, then subject the residuum to percolation with rectified spirit until the latter passes through without being materially coloured; unite the expressed juice and the percolated tincture, filter, distil off the spirit, and evaporate in a vapour or a water bath to a proper consistence. Stronger than the preceding.

Obs. A variable and uncertain preparation. Numbness and tingling follow its application to the limbs or tongue when it is of good quality.—*Product.* 1 cwt. of fresh leaves yield between 5 lbs. and 6 lbs. of extract.—*Prop.* Anodyne, sudorific, and narcotic; very poisonous.—*Dose,* ½ gr. to 2 gr., made into a pill with liquorice powder; once or twice a day, in neuralgic pains, chronic rheumatism, glandular swellings, &c., gradually and cautiously increased to 5 or 6 gr.

4. (Alcoholic: E. A. ALCOHOLICUM, L.) *a.* (P. Cod.) Aconite (in coarse powder), 1 lb.; proof spirit, 3½ lbs. (say 2½ pints); proceed by the method of displacement, and when all the spirit has penetrated the powdered mass, keep this covered with distilled water, until the liquid begins to cause a precipitate in falling into that which has previously passed through; next distil the spirit from the tincture, and evaporate the residuum to the proper consistence.

b. (Ph. U. S.) Aconite, 1 lb.; spirit, sp. gr. ·935 (= 13 u. p.), 1 quart, or q. s.; as last.

c. (Ph. Baden.) From the tincture prepared with rectified spirit, and by either maceration or displacement. Stronger than the last two.

d. (Ph. Bor.) The juice is expressed from the fresh herb, which is then sprinkled with about 1-3rd of its weight of water, and again pressed; the mixed and strained liquid is evaporated in a vapour-bath, at 122° to 140° F., to about one half; to this, as soon as cold, an equal weight of spirit (sp. gr. ·900) is added, and after frequent agitation for 24 hours, the whole is filtered, with pressure; the marc is treated with fresh spirit (equal to about 1-4th that first used) and again pressed; the mixed liquors are next filtered, and are, lastly, evaporated, as before, to the proper consistence.

Obs. Resembles the simple extract, but is much more powerful. It has been exhibited internally in the form of pills, and used externally, combined with ointment or spread on simple plaster. —*Dose,* $\frac{1}{12}$ to $\frac{1}{6}$ gr. every 3 hours.

5. (Ammoniated: E. A. AMMONIATUM, L.) (*Dr Turnbull.*) Extract of aconite, 1 dr.; liquor of ammonia (strongest), 10 or 12 drops; mix.

6. (Dried: E. A. SICCUM, L.) (P. Cod.) The expressed juice, strained through a sieve of coarse linen, is at once, without depuration, exposed in

earthen dishes, in layers of about 2 lines deep, in a stove or current of dry air, to a temperature ranging between 95° and 104° F., until reduced to dryness. The dried extract is to be packed in bottles.

7. (Saccharated: E. A. SACCHARATUM, L.) From extract of aconite (Ph. Bor.), 4 oz.; sugar of milk (in powder), 1 oz.; mix, and dry the mass in a warm place, adding sugar of milk, q. s. to make the whole equal in weight to that of the extract used (4 oz.). An excellent preparation, which keeps well. The other NARCOTIC EXTRACTS, as those of BELLADONNA, HEMLOCK, HENBANE, &c., are to be treated in a similar manner. See ACONITE, and *below*.

Extract of Aconite Root. *Syn.* EXTRACTUM ACONITI RADICIS ALCOHOLICUM, L. *Prep.* (*Dr Fleming; Dr Turnbull.*) From tincture of the root made with rectified spirit. It is said to be 12 times as strong as the extract of the leaves.

Extract of Ag'aric. *Syn.* EXTRACTUM AGARICI, L. *Prep.* (P. Cod.) From the infusion of white agaric (*Polyporus officinalis*) prepared with cold water. Purgative.—*Dose*, 1 to 4 gr.

Extract of Al'oes. *Syn.* PURIFIED ALOES, WASHED A.; EXTRACTUM ALOËS BARBADENSIS (B. P.), EXTRACTUM ALOËS (Ph. L.), E. A. AQUOSUM (Ph. D.), L. *Prep.* 1. (B. P.) Barbadoes aloes, in small pieces, 1 lb.; treated with 1 gall. of boiling water for 12 hours, and the clear liquid evaporated.—*Dose*, 1 to 3 gr.; B. P. 2 to 6 gr.

2. (B. P.) Socotrine aloes, 1 lb., treated with 1 gall. of boiling water for 12 hours, and the clear liquid evaporated to dryness in a current of warm air.

3. (Ph. D.) Aloes (hepatic), 4 oz.; water, 1 quart; boil till dissolved; when cold, decant the clear liquid, and evaporate as before.

4. (Ph. Bor. 1847.) By macerating powdered aloes in cold water for 48 hours, with frequent agitation, and then evaporating in a water-bath at a temperature not exceeding 150° to 165° F., until a pilular consistence is attained.

Obs. The second is the form commonly adopted in the laboratory. When made with the juice of borage, bugloss, &c., it forms the old 'ALOES INSUCCATA.'—*Dose*, 5 to 15 gr. See ALOES and EXTRACT OF BARBADOES ALOES.

Extract of Aloes, prepared with Sulphuric Acid. *Syn.* EXTRACTUM ALOËS ACIDO SULFURICO CORRECTUM. (Germ. Ph.) *Prep.* Dissolve extract of aloes, 8 oz., in distilled water, 32 oz.; then gradually add sulphuric acid, 1 oz. (by weight), and evaporate to a dry extract.

Extract of Anem'one. See EXTRACT OF PASQUE-FLOWER.

Extract of Angel'ica. *Syn.* EXTRACTUM ANGELICÆ, L. *Prep.* 1. (Ph. Baden.) From a tincture of the root, prepared with spirit, sp. gr. ·944 (= 21½ u. p.).

2. (Ph. Bor.) Angelica root and rectified spirit, of each, 2 parts; water, 9 parts; digest, strain, and evaporate. Inferior to the preceding.

3. (*Dr Moir.*) Angelica root, 2 lbs.; rectified spirit, 1 gall.; make a tincture; to the 'marc' add proof spirit, 1 gall., and repeat the digestion; filter the two tinctures separately, mix, distil off the spirit, and evaporate. Balsamic, stomachic, and tonic.—*Dose*, 10 to 20 gr. The last is the most balsamic and agreeable.

Extract of Ap'ples. *Syn.* CHALYBEATED E. OF A.; EXTRACTUM FERRI POMATUM, L. *Prep.* 1. (Ph. Bor.) Crab-apples (unripe), 6 lbs.; peel them and reduce them to a pulp; add iron wire (in small coils), 1 lb.; digest in a vapour-bath for about a week, express, strain, decant, and evaporate in a porcelain vessel, with constant stirring, to the consistence of a soft extract; dissolve the residuum in water, 4 parts, strain and evaporate as before.—*Dose*, 5 to 10 gr.; as a chalybeate tonic. The formula of the Ph. Baden is nearly similar.

2. (Ph. Germ.) Reduce 5 lbs. of unripe apples to a pulp; mix them with cut straw, and press. To the strained juice after removal of the sediment add 1½ oz. of reduced iron. When this has dissolved, to the cooled liquid add as much water as will make up 4⅘ lbs. Filter, and reduce to a thick extract.

Extract of Ar'nica. *Syn.* EXTRACT OF ARNICA FLOWERS; EXTRACTUM ARNICÆ FLORUM, L. *Prep.* 1. (P. Cod.) From the dried flowers, as ALCOHOLIC EXTRACT OF ACONITE (P. Cod.).

2. (Ph. Græca, 1837.) From a tincture of the flowers, prepared with rectified spirit, 3 parts; and water, 5 parts.—*Dose*, 2 to 6 gr.; as a stimulant in various diseases accompanied with debility, deficient nervous sensibility, paralysis, dropsies, diarrhœa, amenorrhœa, dysentery, &c.

Extract of Arnica Root. *Syn.* EXTRACT OF ARNICA; EXTRACTUM ARNICÆ RADICIS, L. *Prep.* 1. (Ph. Baden.) As EXTRACT OF ANGELICA—Ph. Baden.

2. (Ph. Græcæ.) From tincture of the root, prepared as No. 2 (*above*). The form of the Hamburg Codex is nearly similar.—*Dose*, &c., as the last.

Extract of Art'ichoke. *Syn.* EXTRACTUM CYNARÆ, L. *Prep.* From the fresh leaves of the artichoke, as EXTRACT OF ACONITE—Ph. L. —*Dose*, 3 to 6 gr., twice or thrice daily; in rheumatism, &c.

Extract of Aspar'agus. *Syn.* EXTRACTUM ASPARAGI, L. *Prep.* 1. (*Soubeiran.*) From the expressed juice of the shoots, clarified and evaporated by a gentle heat.

2. From the juice of the roots, as No. 1. Both are diuretic.—*Dose*, 15 gr. to ½ dr., or more.

Extract of Bael. *Syn.* EXTRACTUM BELÆ LIQUIDUM, L. (B. P.). Bael, 1; distilled water, 15; rectified spirit, ⅛; macerate for 12 hours in 5 of the water, pour off the liquid, repeat the operation twice for 1 hour; press, filter, and evaporate to 1, including the spirit. A fluid ounce is equal to a solid ounce.—*Dose*, 1 to 2 dr.

Extract of Bark. See EXTRACT OF CINCHONA.

Extract of Belladon'na. *Syn.* EXTRACT OF DEADLY NIGHTSHADE, INSPISSATED JUICE OF BELLADONNA; EXTRACTUM BELLADONNÆ (B. P., Ph. L. E. & D.), SUCCUS SPISSATUS BELLADONNÆ, L. *Prep.* 1. (B. P.) Take 112 lbs. of fresh leaves and tender branches, bruise in a stone mortar or other suitable apparatus, and press out the juice, heat it gradually to 130° F., separate the green colouring matter by a calico filter, heat the strained liquor to 200° F. to coagulate the albumen, and again filter; evaporate the filtrate

by a water-bath to the consistence of a thin syrup, then add to it the green colouring matter previously separated, and, stirring the whole together assiduously, continue the evaporation at a temperature not exceeding 140° F., until the extract is of a suitable consistence for forming pills. —*Dose,* ¼ to ½ gr., gradually increased to 1 or 2 gr.

2. (Ph. E.) Express the juice from the bruised fresh plant, sprinkle the 'marc' with water, and again apply pressure; mix the expressed liquids, filter them, and evaporate the filtered liquor in a vapour-bath to the consistence of an extract.

3. (Ph. D.) From the leaves, collected when the plant begins to flower. The expressed juice is allowed to stand for 24 hours, and the clear portion is decanted; the sediment is placed on a calico filter, washed with an equal bulk of cold water, and the filtrate mixed with the expressed juice. The mixed liquid is next heated in a water-bath to coagulate its albumen, and after being skimmed and filtered through flannel whilst hot the washed sediment is added, and the whole evaporated as before.

4. (Ph. U. S.) The expressed juice is heated to the boiling-point, filtered and evaporated (see *below*).

Obs. The P. Cod. directs this extract to be made by two different formulæ. The product of the one resembles that of the Ph. L.; that of the other that of the Ph. E. That of the Ph. L., from retaining the fecula, is the weakest preparation.—*Dose,* ½ gr. to 1 gr., gradually increased to 3 or 4 gr.; as an anodyne in neuralgia, tic-douloureux, &c.; as an antispasmodic to relieve rigidity and spasms, in various affections of the uterus, rectum, urethra, bladder, &c., and in hooping-cough; in various maladies of the eyes; and as a resolvent and discutient in several glandular diseases. It has been highly recommended as a preservative against scarlet fever. It is most frequently employed externally, under the form of a plaster, ointment, or lotion. It is poisonous.

EXTRACTUM BELLADONNÆ ALCOHOLICUM; ALCOHOLIC EXTRACT OF BELLADONNA (B. P.). Exhaust belladonna root in No. 20 powder with rectified spirit. Evaporate the liquid by a water-bath until the extract has a suitable consistence.

Obs. The above is much more powerful than the common extract, and is chiefly used in external applications. See BELLADONNA, and *below.*

Extract of Belladonna Ber′ries. *Syn.* EXTRACTUM BACCARUM BELLADONNÆ, L. *Prep.* (P. Cod.) From the expressed juice of the berries, evaporated to the consistence of thick honey. —*Dose,* 1 to 5 gr.

Extract of Bis′tort. *Syn.* EXTRACTUM BISTORTÆ, L. *Prep.* 1. (P. Cod.) From the dried root of bistort or snakeweed (*Polygonum bistorta*), by percolation with temperate distilled water.

2. From the infusion made with boiling water, or from the decoction. Astringent and tonic.—*Dose,* 10 gr. to ½ dr.

Extract of Bitter-sweet. *Syn.* EXTRACT OF WOODY NIGHTSHADE; EXTRACTUM DULCAMARÆ, L. *Prep.* 1. From the decoction of the stalks.

2. (Ph. U. S.) From the dried stalks, by percolation with temperate water. Diaphoretic, diuretic, and narcotic.—*Dose,* 3 to 6 gr.; in chronic asthma, rheumatism, and chest diseases; and particularly in chronic skin diseases.

Extract, Black. See EXTRACT OF COCCULUS.

Extract of Black Pepper. See EXTRACT OF PEPPER.

Extract of Bladder-wrack. *Syn.* EXTRACTUM FUCI VESICULOSI. From the dried plant of the bladder-wrack. Given in obesity.

Extract of Bor′age. *Syn.* EXTRACTUM BORAGINIS, L. *Prep.* 1. (P. Cod.) From the dried herb (*Borago officinalis*).

2. (Ph. Lusit.) From the clarified juice of the fresh plant. Exhilarating, restorative, and pectoral.—*Dose,* 10 to 30 gr., or more.

Extract of Box. *Syn.* EXTRACTUM BUXI, E. CORTICIS B., L. *Prep.* (P. Cod.) From the tincture of the root bark, prepared (with proof spirit) by displacement, as EXTRACT OF ACONITE (P. Cod.).

Extract of Broom. *Syn.* EXTRACT OF BROOM-TOPS; EXTRACTUM SCOPARII, E. SPARTII SCOPARII, L. From decoction of broom-tops. Diuretic and cathartic; and, occasionally, emetic. —*Dose,* 20 gr. to 1 dr.; in dropsy, &c. It is now seldom used.

Extract of Bry′ony. *Syn.* EXTRACTUM BRYONIÆ, E. B. ALBÆ, E. RADICIS B. A., L. *Prep.* From the infusion or decoction of the root of white bryony (*Bryonia dioica*). Purgative, diuretic, and emmenagogue.—*Dose,* 10 gr. to ½ dr. It was once a favourite remedy in asthma, dropsy, epilepsy, &c.

Extract of Bu′chu. *Syn.* EXTRACTUM BUCHU, E. DIOSMÆ, L. *Prep.* 1. From buchu leaves, as the last.

2. (Ethereo-alcoholic: E. B. ÆTHERO-ALCOHOLICUM, L. *W. Procter.*) Buchu (in coarse powder), 1 lb.; ether, 4 fl. oz.; alcohol (rectified spirit), 12 fl. oz.; percolate without digestion, adding dilute alcohol until a pint of ethereo-alcoholic tincture is obtained, and suffer this to evaporate spontaneously; treat the residue in the displacer with dilute alcohol till 2 pints are obtained; evaporate to a syrup, add the product of the first tincture, mix, and complete the evaporation.—*Dose,* 5 to 10 gr.; in diseases of the urinary organs, &c.

3. (Fluid: E. B. FLUIDUM, L. *W. Procter.*) Buchu leaves, 8 oz.; rectified spirit, 16 fl. oz.; for a tincture by displacement, adding water, until 12 fl. oz. have passed through; allow this to evaporate spontaneously until reduced to one half; next digest the mass in the percolator with cold water, 1 pint, for 12 hours, express a pint and evaporate this to 10 fl. oz.; lastly, add the 6 fl. oz. of residual tincture, agitate together, and in a few days filter or decant the clear portion.—*Dose,* 1 to 2 teaspoonfuls. See DIOSMA.

Extract of Buck′bean. *Syn.* EXTRACTUM MENYANTHIS, L. *Prep.* 1. (P. Cod.) From the expressed juice of the fresh plant.

2. (Ph. Bor.) From the infusion made with boiling water. Bitter, tonic, and astringent.—*Dose,* 5 to 10 gr. In large doses it is purgative, cathartic, and even emetic.

Extract of Buck′thorn. *Syn.* EXTRACTUM RHAMNI, E. BACCARUM R., L. *Prep.* From the

filtered expressed juice of buckthorn berries. Some persons allow it first to run into a state of fermentation; but the quantity of the product is thereby greatly lessened. Hydragogue and purgative.—*Dose*, 15 gr. to 1 dr., or more.

Extract of Bur′dock. *Syn.* EXTRACTUM BARDANÆ, L. *Prep.* 1. From the decoction of burdock root.

2. (P. Cod.) As EXTRACT OF BISTORT (P. Cod.). In gout, rheumatism, skin diseases, &c. —*Dose*, 10 gr. to 1 dr. Sir Robert Walpole praised burdock root as a gout medicine; and others have considered it an excellent substitute for sarsaparilla (*Lindley*).

Extract of Butter-nut. *Syn.* EXTRACTUM JUGLANDIS, L. *Prep.* (Ph. U. S.) From the inner bark of the root of the butter-nut or white walnut (*Juglanda alba*), as EXTRACT OF BITTER-SWEET—Ph. U. S. A mild, yet efficacious aperient and vermifuge.—*Dose.* As a laxative, 5 to 10 gr.; as a purgative, 15 to 30 gr.

Extract of Calabar Bean. *Syn.* EXTRACTUM PHYSOSTIGMATIS (B. P.). Calabar bean in coarse powder, 1; rectified spirit, 5; macerate the bean for 48 hours in 1-4th of the spirit in a closed vessel, agitating occasionally, then transfer to a percolator, and when the fluid ceases to pass add the remainder of the spirit, so that it may slowly penetrate through the powder; subject the residue of the bean to pressure, adding the pressed liquid to the product of the percolation; distil off the spirit, and evaporate what is left to the consistence of a soft extract by a water-bath. —*Dose*, $\frac{1}{16}$ to $\frac{1}{4}$ gr.

Extract of Calum′ba. *Syn.* EXTRACTUM CALUMBÆ, E. RADICIS C., L. *Prep.* 1. (B. P.) Calumba, cut small, 1; water, 5; macerate in half the water for 12 hours, strain, and press; macerate again with the remaining water, strain, and press; mix and filter the liquors, and evaporate with the heat of a water-bath to pill consistency. —*Dose*, 2 to 10 gr.

2. (Alcoholic: Ph. Bor.) Nearly as No. 3 (*below*), but using stronger spirit; the evaporation is to be conducted at a heat not above 167° F., until it acquires the consistence of a pill-mass, which, after being rendered quite dry by a very gentle heat, is to be reduced to fine powder. It should have a brownish-yellow colour, and give a turbid solution with water.—*Dose*, 4 to 12 gr. They are all tonic and stomachic.

3. (Spirituous: P. Cod.) As EXTRACT OF BOX. The Ph. Baden orders spirit of ·944 to be used. —*Dose*, 5 to 15 gr.

Extract of Cannabis Indica. See EXTRACT OF INDIAN HEMP.

Extract of Canthar′ides. *Syn.* EXTRACT OF SPANISH FLIES; EXTRACTUM CANTHARIDIS, E. LYTTÆ, L. *Prep.* 1. (P. Cod.) From the tincture, as EXTRACT OF BOX.

2. (*Soubeiran.*) From a tincture prepared with spirit of the sp. gr. ·923 (about 2 u. p.).

3. (Acetic: E. C. ACETICUM, L.) From a tincture prepared with acetic acid, sp. gr. 1·048.

4. (Ethereal: E. C. ÆTHEREUM, L.) From the ethereal tincture.

Obs. The ether, acid, and spirit distilled from the above must be either thrown away or used to make fresh extract, as it is highly poisonous. They are all for external use only, and should have the consistence of soft butter.

Extract of Car′damoms. *Syn.* ETHEREAL E. OF C.; EXTRACTUM CARDAMOMI ÆTHEREUM, L. *Prep.* (*W. Procter.*) By spontaneous evaporation of the ethereal tincture. It consists of the volatile and fixed oils of the seeds, and is used to aromatise pills, powders, &c.

Extract of Ca′rob Beans. *Syn.* EXTRACTUM CERATONIÆ, L. *Prep.* From the decoction of the pods (CAROB OR ALGAROBA BEANS) of the *Ceratonia siliqua*, or 'St John's bread tree.' See ALGAROBA.

Extract of Caroli′na Pink. See EXTRACT OF PINK-ROOT.

Extract of Cascaril′la. *Syn.* EXTRACTUM CASCARILLÆ, E. CORTICIS C., L. *Prep.* 1. (*Guibourt.*) From the alcoholic (rectified spirit) tincture.

2. (Ph. Baden.) As the last, but using spirit of the sp. gr. ·944.

3. (Ph. L. 1788.) As EXTRACT OF JALAP—Ph. L.

Obs. This extract is tonic, aromatic, and stomachic.—*Dose*, 5 to 15 gr., or more, 2 or 3 times a day. 28 lbs. of bark yield about $5\frac{1}{4}$ lbs. of extract.

Extract of Cas′sia. *Syn.* EXTRACTUM CASSIÆ, L. See CASSIA PULP.

Extract of Cat′echu. *Syn.* EXTRACTUM CATECHU, L. *Prep.* 1. From decoction of catechu.

2. (P. Cod.) From the infusion in boiling water. Astringent and tonic.—*Dose*, 5 to 25 gr. See CATECHU.

Extract of Cel′andine. *Syn.* EXTRACTUM CHELIDONII, L. *Prep.* 1. (Ph. Bor.) From the herb (*Chelidonium majus*), as ALCOHOLIC EXTRACT OF ACONITE (Ph. Bor.).—*Dose*, 3 to 10 gr.

2. (*Van Mons.*) From the expressed juice, coagulated by heat, filtered, and evaporated, towards the end adding the coagulum.—*Dose*, 5 to 15 gr., or more. Used as a drastic hydragogue in dropsies; and in scrofula, &c.

Extract of Cen′taury. *Syn.* EXTRACTUM CENTAURII, L. Extracts under this name are prepared from 'American centaury' (*Sabbatia angularis*) and 'common centaury' (*Erythræa centaurium*). *Prep.* 1. By evaporating the decoction, or the infusion made with hot water. The dose and properties resemble those of extract of gentian.

2. (Alcoholic: E. C. ALCOHOLICUM, L.) As EXTRACT OF BOX (see *above*).

Extract of Cevadil′′la. *Syn.* ALCOHOLIC EXTRACT OF SABADILLA; EXTRACTUM SABADILLÆ, L. *Prep.* (*Dr Turnbull.*) From tincture of cevadilla seeds, made with rectified spirit. Employed by Dr Turnbull as a remedy in painful rheumatic and neuralgic affections, and, generally, as a substitute for VERATRIA.—*Dose*, $\frac{1}{10}$ to $\frac{1}{6}$ gr. It is extremely poisonous.

Extract of Cham′omile. *Syn.* EXTRACTUM ANTHEMIDIS (Ph. E.), E. A. NOBILIS, L. *Prep.* By evaporating the decoction of the flowers to the proper consistence.

Obs. This extract contains only the bitter portion of the chamomile, the aromatic volatile oil being dissipated during the evaporation. This, however, is remedied in the formulæ given by the British Pharmacopœia, which is as follows:

Boil chamomile flowers, 1 lb., in 1 gall. of distilled water, until the volume is reduced to $\frac{1}{2}$; strain, press, and filter. Evaporate by a water-bath to a proper consistence, adding oil of chamomile, 15 minims, at the end of the process.

It is usually prepared from old flowers that have lost their smell and colour, and are thus rendered unsaleable. The extract of chamomile that smells strongly of the flowers, frequently vended by the druggists, is prepared by adding 1 dr. of the essential oil of chamomile to every pound of extract, when nearly cold, and just before removing it from the evaporating pan. This addition, unlike many which are made in the laboratory, vastly increases the medicinal virtues of this article. The mass of extract of chamomile met with in the shops is nothing but extract of gentian scented with a little oil of chamomile. 1 cwt. of chamomiles yields about 48 lbs. of extract.

Extract of chamomile is bitter, tonic, and stomachic.—*Dose*, 10 to 30 gr., made into a pill, either alone or combined with a little rhubarb and ginger. See PILLS, &c.

Extract of Chenopo″dium. *Syn.* EXTRACT OF STINKING GOOSEFOOT; EXTRACTUM CHENOPODII, L. *Prep.* 1. From the stinking orache or goosefoot (*Chenopodium olidum*), as EXTRACT OF ACONITE (Ph. L.).

2. (*Mr Houlton.*) From the expressed juice by spontaneous evaporation. A better plan is to expose it to heated air. Antihysteric, emmenagogue, and vermifuge.—*Dose*, 5 to 20 gr.

Extract (Fluid) of Wild Cherry. *Syn.* EXTRACTUM PRUNI VIRGINIANÆ FLUIDUM (Ph. U. S.). Wild cherry in fine powder, 16 oz. (troy); glycerin, 4 oz. (old measure); water, 8 oz. (old measure). Mix the glycerin and the water, and digest the wild cherry in 8 oz. of the mixture for 4 days, then pack in a percolator and pour on the remaining 4 oz. of glycerin and water. When this has disappeared from the surface pour on rectified spirit (·817) until 12 oz. (old measure) of fluid have been obtained, and set this portion aside. Then percolate with spirit until 20 oz. (old measure) more have been obtained; evaporate to 4 oz. (old measure), and mix with the reserved portion.

Extract of Cincho′na. *Syn.* EXTRACT OF BARK. Three simple extracts, prepared respectively from YELLOW, PALE, and RED CINCHONA, are given in Ph. L. *Prep.* 1. (From CALISAYA or YELLOW BARK: EXTRACT OF CINCHONA, E. OF YELLOW C., E. OF HEART-LEAVED C.; EXTRACTUM CINCHONÆ, L.) *a.* EXTRACTUM CINCHONÆ LIQUIDUM; LIQUID EXTRACT OF CINCHONA (B. P.). Red cinchona bark in No. 60 powder, 20 oz.; hydrochloric acid, 5 dr.; glycerin, $2\frac{1}{2}$ oz.; rectified spirit and distilled water, of each, a sufficiency. Mix the bark with 5 pints of the water to which the acid and glycerin have been added, and macerate in a covered vessel for 48 hours, stirring frequently; then transfer to a percolator, and when the fluid ceases to pass, and the contents of the percolator have been perfectly packed, continue the percolation with water until 15 pints of liquid have passed, or that which is passing has ceased to give a precipitate with solution of soda. Evaporate the liquid in a porcelain vessel at a temperature not exceeding 82° C. until it measures 20 oz. Put 50 fl. gr. of this liquid with $\frac{1}{2}$ oz. of distilled water into a stoppered glass separator capable of holding 4 fl. oz.; add to this 1 fl. oz. of benzolated amylic alcohol and $\frac{1}{2}$ oz. of solution of soda, shake them together thoroughly and repeatedly, then allow them to remain at rest until the spirituous solution of the alkaloids shall have separated and formed a distinct stratum over the dark-coloured alkaline solution of the other constituents of the extract. Run off the latter by the stopcock, add a little more distilled water to wash away any still-adhering alkaline solution from the separator and its contents, and having run off this as before, as completely as possible, decant the spirituous solution into a porcelain or glass dish of known weight, and evaporate to dryness. The weight of the dish and its contents, after deducting the weight of the dish, will give that of the alkaloids; this multiplied by 2 will give the parts by weight in 100 fluid parts of the liquid (*a*).

Now take of the liquid (*a*) such portion as will equal or contain 5 gr. of total alkaloids, then by addition of water or by evaporation bring to the volume of 84 gr., then add $12\frac{1}{2}$ gr. of rectified spirit, finally adjusting to 100 fl. gr. by addition of distilled water.

The extract contains 5 gr. of alkaloids in 100 fl. gr.—*Dose*, 5 to 10 minims.

b. (Ph. L.) Yellow cinchona (coarsely bruised), 3 lbs.; distilled water (temperate), 4 pints; macerate for 24 hours (constantly stirring), and strain through linen; what remains, again macerate in water, 1 quart, for 24 hours, and strain; evaporate the mixed liquids to a proper consistence.

2. (From PALE BARK: EXTRACT OF PALE CINCHONA, E. OF PALE BARK, E. OF LANCE-LEAVED B.; EXTRACTUM CINCHONÆ VALLIDÆ, L.) *a.* (Ph. L.) From pale bark, as EXTRACT OF CINCHONA (Ph. L.) (*above*).

b. (Ph. L. 1836.) From the decoction.

Obs. This forms the EXTRACT OF BARK of the shops. The red and yellow cinchona barks are scarcely ever used for making extracts. Their richness in quinine leads to their almost exclusive employment for the manufacture of that alkaloid, by which their value is greatly enhanced. As far as our knowledge extends, no other extract of bark than this is either employed or asked for.

3. (From RED BARK: EXTRACT OF RED CINCHONA, E. OF RED BARK, E. OF OBLONG-LEAVED B.; EXTRACTUM CINCHONÆ RUBRÆ, L.) *a.* (Ph. L.) From red bark, as EXTRACT OF CINCHONA (Ph. L.) (*above*).

b. (Ph. L. 1836.) From the decoction.

Obs. These extracts are ordered to be kept in two states, the one (SOFT EXTRACT OF CINCHONA; EXTRACTUM CINCHONÆ MOLLE) for making pills, &c.; the other (HARD EXTRACT OF CINCHONA; EXTRACTUM CINCHONÆ DURUM) for powdering.—The dose, &c., of all the above are the same.

4. (Dry: ESSENTIAL SALT OF BARK; EXTRACTUM CINCHONÆ SICCUM, L.) *a.* (P. Cod.) From an aqueous infusion of pale bark (prepared by displacement with water at a temperature not above 77° F.), evaporated to the consistence of a thick syrup, and then spread thinly and uniformly on earthenware dishes, or sheets of glass, and dried in a stove by a very gentle heat. It is separated

from the plates with a knife, and preserved in well-closed phials. Prior to spreading it out on the plates, about 4% or 5% of thick mucilage is commonly added.

b. (Ph. Bor.) As the above (nearly).

c. (Ph. Hann. 1831.) Similar to the above; but the liquid, when it acquires the consistence of treacle, is diluted with water, and again evaporated to a like consistence; and this dilution and evaporation is repeated until, on the addition of water, it forms a clear solution.—*Dose,* 5 to 25 gr. The product of the last formula is nearly inert, and that of the others possesses little activity.

5. (Fluid: EXTRACTUM CINCHONÆ FLUIDUM, L.) *a.* See LIQUOR OF CINCHONA.

b. (*Dr Neligan.*) From yellow bark, as FLUID EXTRACT OF BUCHU.

6. (Resinous: ALCOHOLIC EXTRACT OF BARK; EXTRACTUM CINCHONÆ ALCOHOLICUM, E. CINCHONÆ, L.) *a.* (Ph. E.) From any variety of cinchona bark (in powder), 4 oz.; proof spirit, 24 fl. oz.; prepare a tincture by displacement, distil off most of the spirit, and evaporate the residuum to the consistence of an extract. This is only EXTRACTUM CINCHONÆ of the Edinburgh College.

b. (Ph. U. S.) Peruvian bark, 1 lb.; rectified spirit, 4 pints; make 4 pints of tincture by displacement; add water to the mass in the percolator, digest and obtain 6 pints of infusion; distil off the spirit from the tincture, and evaporate the infusion to the consistence of syrup, then mix the two and complete the evaporation. More active than the aqueous extract.—*Dose,* 5 to 20 gr.

c. (*Ellis.*) Yellow bark, 2 lbs.; hydrochloric acid, 4 fl. dr.; water, 1 gall.; boil, strain, and repeat the decoction, filter and agitate it with fresh-slaked lime, 2½ oz.; filter or decant; dry the residuum, and exhaust it with hot alcohol, q. s.; lastly, evaporate the alcoholic tincture to a pilular consistence.—*Dose,* 1 to 5 gr. Some persons have proposed to call this 'ESSENTIAL SALT OF BARK.'

7. (Vinous: EXTRACTUM CINCHONÆ VINOSUM, L.) (Ph. Hesse.) Peruvian bark (in powder), 1 part; white wine (sherry), 8 parts; digest 3 days, express, filter, and evaporate.

Extract of Coc'culus. *Syn.* EXTRACT OF COCCULUS INDICUS, BLACK EXTRACT, EXTRACT (Brewer's), BEER STRENGTHENER, HARD MULTUM; EXTRACTUM COCCULI, E. C. INDICI, L. *Prep.* From *Cocculus indicus,* by decoction. It is kept in two states—one having the consistence of thick treacle, the other that of a pilular extract. The first is 'put up' in bladders, the last is made into ½-lb. rolls, like lead-plaster or roll-chocolate. It is narcotic and poisonous, and is employed by fraudulent brewers and publicans to give a false strength to their liquors. See COCCULUS INDICUS, BEER, &c.

Extract of Col'chicum. *Syn.* EXTRACT OF MEADOW SAFFRON, E. OF THE CORMS OF COLCHICUM; EXTRACTUM COLCHICI (B. P.). *Prep.* 1. (B. P.) The expressed juice of fresh colchicum corms, cleared of deposit, boiled, strained, and evaporated to a consistency at a temperature of 160° F.—*Dose,* 1 to 2 gr.

2. (Wholesale.) From the decoction of the dried corms.—*Prod.,* 50% to 55%.

Obs. This extract is given in the usual cases in which colchicum is employed.—*Dose,* 1 to 4 gr., every 3rd or 4th hour (*Thomson*). "A favourite remedy of Dr. Hue of St. Bartholomew's Hospital, in the early stages of acute rheumatism. The dose is 1 gr. every 4 hours" (*Pereira*).

3. (Acetic: ACETIC EXTRACT OF MEADOW SAFFRON; EXTRACTUM COLCHICI ACETICUM.) (B. P.) *a.* (B. P.) Crushed fresh corms, previously peeled, 19; acetic acid, 1; stir together, press, boil, and strain through flannel, and evaporate to a soft extract.—*Dose,* 1 to 2 gr., with an equal weight of liquorice powder.

b. (Wholesale.) Dried corms, 14 lbs.; acetic acid (pyroligneous), 6 pints; distilled water, 5¼ gall.; digest for 14 days, express, filter, and evaporate.—*Prod.,* 2½ to 3 lbs.

Obs. The above extracts are generally prepared from the dried corms, and hence the very uncertain and inferior quality of those commonly met with. They also possess less activity than pharmacopœial preparations. They rapidly get dry and crumbly, and, unless a little spirit and oil of cloves are added, will scarcely keep a week in warm weather without becoming mouldy.—*Dose,* 1 to 3 gr. 2 to 3 times a day. It is much stronger than the common extract, and contains the acetate of colchicine. Sir C. Scudamore prefers the acetic extract prepared by the formula *b* (*above*).

4. (Alcoholic: EXTRACTUM COLCHICI ALCOHOLICUM, L.) (P. Cod.) As EXTRACT OF BOX. More active than even the acetic extract. All the preparations of colchicum are poisonous in large doses.

Extract of Col'ocynth. *Syn.* EXTRACT OF BITTER APPLE; EXTRACTUM COLOCYNTHIDIS (Ph. L. and E.), E. C. SIMPLEX, E. C. MOLLE, L. *Prep.* 1. (Ph. L.) From colocynth pulp (cut in pieces and the seeds removed), by simple maceration in cold water for 36 hours, frequently pressing it with the hands, and afterwards strongly pressing out the liquor, which must be strained before evaporating it.

2. (Ph. E.) From the decoction. This is the plan adopted at Apothecaries' Hall, and in the laboratory generally. Many houses do not even remove the seeds.

Obs. This extract rapidly gets hard, crumbly, and mouldy by keeping. For the remedy, see observations on EXTRACT OF COLCHICUM, *above.*—*Dose,* 5 gr. to 20 gr.; as a cathartic. Colocynth pulp yields above 65% of extract.

3. (Alcoholic: EXTRACTUM COLOCYNTHIDIS ALCOHOLICUM, L.) *a.* (Ph. Baden.) As EXTRACT OF ANGELICA (Ph. Bad.).

b. (P. Cod.) From a tincture prepared with proof spirit. Much more active than the simple extract.—*Dose,* 2 to 7 gr.

4. (Dry: EXTRACTUM COLOCYNTHIDIS SICCUM, L.) (Ph. Bor.) As the last, but using spirit of the sp. gr. ·900 (about 16 o. p.), digesting at a tepid heat, evaporating to dryness, and powdering.—*Dose,* 1 to 6 gr.

Extract of Colocynth (Compound). *Syn.* COMPOUND EXTRACT OF BITTER APPLE, CATHARTIC EXTRACT; EXTRACTUM CATHARTICUM, E. COLOCYNTHIDIS COMPOSITUM (B. P.). *Prep.* 1.

(B. P.) Colocynth free from seeds, 6; extract of Socotrine aloes, 12; scammony, or resin of scammony, in powder, 4; hard soap in powder, 3; cardamoms free from capsules in fine powder, 1; proof spirit, 160. Macerate the colocynth in the spirit for 4 days, press out the tincture, distil off the spirit, and add to it the extract of aloes, the soap, and the scammony; then evaporate the residue by a water-bath to a pilular consistence, adding the cardamoms towards the end of the process.—*Dose*, 2 to 5 gr., with 2 or 3 gr. of extract of hyoscyamus to prevent griping.

2. (Ph. L. 1836.) Colocynth pulp (sliced, without the seeds), 6 oz.; proof spirit, 1 gall.; digest with a gentle heat for 4 days, express, strain, and add of extract of aloes (Ph. L. 1836), 12 oz.; powdered scammony, 4 oz.; Castile soap (cut small), 3 oz.; and evaporate (distil) to a proper consistence; adding, towards the last, powdered cardamoms, 1 oz.

3. (Wholesale.) The formulæ adopted by the wholesale druggists are mere modifications of that of the Ph. L. 1809; water being used instead of spirit as the menstruum, with actual benefit, as we honestly believe, to the quality of the preparation. The following are extensively employed by those who deal largely in this article, and we can speak highly of the quality of the products obtained by their use.

a. Turkey colocynth, 18 lbs., is boiled in about 20 times its weight of water for 5 or 6 hours; to the strained decoction is added hepatic aloes, 40 lbs., which are boiled until dissolved, when the solution is decanted. In the meantime the colocynth is exhausted with a second quantity of water (less than the first), and the strained liquor is added to the undissolved residuum of the aloes, and boiled for a few minutes; after which it is drawn off and mixed with the first decoction of aloes; the mixed liquors are then allowed to stand until quite cold (commonly until the next day), to deposit the resinous portion. The liquor is next decanted or drawn off, and set evaporating as quickly as possible; as soon as the consistence of treacle is arrived at, the whole is allowed to cool considerably, and moist sugar (clean), 4 lbs., and Castile soap, 10 lbs. (previously melted with a little water), are added; powdered scammony, 6 lbs., is next gradually sifted in, the extract all the time being assiduously stirred by a second person. Lastly, the heat is further moderated, and the stirring continued until a rather harder consistence is acquired than is proper for the extract, when the steam is wholly 'shut off,' or the vessel removed from the heat, and as soon as the whole has become sufficiently cool to prevent any considerable evaporation of the spirit, essence of cardamoms, 2 lbs. (say 1 quart), is expertly stirred in; and the extract at once (whilst still warm) put into stone jars or pots, and tied or covered over for store or use. The product is usually labelled 'EXT. COLOCYNTH. COMP. OPT.' It looks well, and smells very aromatic, and is really an excellent preparation.

b. Turkey colocynth, $2\frac{1}{4}$ lbs.; hepatic aloes, $5\frac{1}{2}$ lbs.; powdered scammony, $1\frac{1}{2}$ lbs.; powdered cardamoms, 6 oz. (or essence, $\frac{1}{2}$ pint); Castile soap (genuine), 1 lb. 2 oz.; pale moist sugar, $\frac{1}{2}$ lb.; proceed as last. This produces a beautiful article, and of unquestionable quality, equally effective, and milder in its action than the College preparation. It is labelled and sent out as 'EXT. COLOCYNTH. COMP.' (Ph. L. 1836).

4. (Ph. L. 1809.) Colocynth, 6 dr. (6 parts); aloes, $1\frac{1}{2}$ oz. (12 parts); scammony, $\frac{1}{2}$ oz. (4 parts); hard soap, 3 dr. (3 parts); cardamoms, 1 dr. (1 part); as No. 3, *a* (nearly).

Qual., &c. Compound extract of colocynth is often adulterated with acrid cathartics to make up for the deficiency or inferiority of its proper ingredients, and foreign matter often becomes mixed with it by the use of impure scammony. The presence of Cape aloes may usually be detected by the nauseous odour; chalk (an article frequently present in bad scammony), by placing a little ball of the extract in a glass tube, and pouring over it some dilute hydrochloric or acetic acid, when an effervescence will ensue if that substance be present; jalap, scammony adulterated with fecula, and other starchy substances, by the filtered decoction of the extract turning blue on the addition of tincture of iodine; gamboge, by the decoction becoming deep red on the addition of liquor of potassa, and by a filtered alcoholic solution of the extract forming a yellow emulsion with water, which becomes transparent and assumes a deep red colour on the addition of caustic potassa; and further, by this solution (if the alkali is not in excess) giving a yellow precipitate with acids and with acetate of lead, a brown precipitate with sulphate of copper, and a very dark brown one with the salts of iron; also by the ethereal solution of the extract dropped on water yielding an opaque yellow film, soluble in caustic potassa if it contains gamboge.

Dose, 3 gr. to 15 gr. It is a safe and mild, yet certain, purgative. It may be mixed with calomel without the latter being decomposed.

Obs. There are few formulæ which have undergone so many alterations in the hands of the College as that for compound extract of colocynth. Before 1809, proof spirit was ordered to be employed as the menstruum, and, omitting the soap, the preparation resembled that of the Ph. L. 1836. In 1809, the College directed water to be used instead of spirit, and added a certain quantity of soap. In the next edition of the Pharmacopœia (1815) the soap was again omitted; but in the edition of 1824 the formula of 1809 was again adopted, substituting, however, proof spirit for the water. These directions were also continued in the edition of 1836. In the London Pharmacopœia (1851) the formula for this extract is omitted altogether, and in its place a pill (PILULA COLOCYNTHIDIS COMPOSITA) is inserted.

Extract of Conia. See EXTRACT OF HEMLOCK.

Extract of Contrayer′va. *Syn.* EXTRACTUM CONTRAYERVÆ, L. *Prep.* (Palat. Cod.) From contrayerva root, as EXTRACT OF CINCHONA (Ph. L.).—*Dose*, 10 gr. to $\frac{1}{2}$ dr.; as a diaphoretic tonic in low conditions of the system.

Extract of Copai′ba. *Syn.* RESINOUS EXTRACT OF COPAIBA; EXTRACTUM COPAIBÆ, E. C. RESINOSUM, L. *Prep.* (*Mr Thorn.*) From balsam of

copaiba, by distilling off the oil until the residuum assumes the consistence of an extract.—*Dose*, 10 to 20 gr., or more, as a diuretic.

Extract of Copal'che. *Syn.* EXTRACTUM COPALCHI, E. CORTICIS C., L. *Prep.* From copalchi bark (*Croton pseudo-China*), as EXTRACT OF CASCARILLA, which it for the most part resembles.—*Dose*, 1 to 3 gr.

Extract (Fluid) of Cotton Root. *Syn.* EXTRACTUM GOSSYPII RADICIS FLUIDUM (Ph. U. S.). Cotton root in very fine powder, 16 oz. (troy); macerate with glycerin, 3 fl. oz. (old measure); rectified spirit, 8 oz. (old measure); water, 5 oz. (old measure), in closed percolator for 4 days; then let the percolation commence, and finish it by adding dilute alcohol (eq. vols. of alcohol ·835 and water) until 24 oz. (old measure) have been obtained; reserve the first 14 oz., and evaporate the remaining 10 oz. (to which previously add 1 fl. oz., old measure) of glycerin to 2 fl. oz. (old measure), and mix with the reserved portion.

Extract of Couch-grass. *Syn.* EXTRACT OF DOG'S GRASS; EXTRACTUM GRAMINIS, L. *Prep.* 1. (P. Cod.) From the root of couch-grass, or dog's grass (*Triticum repens*), as EXTRACT OF BISTORT (P. Cod.).

2. From the fresh root, as EXTRACT OF ACONITE (Ph. L.).

3. (Fluid: MELLAGO GRAMINIS, EXTRACTUM GRAMINIS FLUIDUM, L.) (Ph. Hann. 1831.) From the decoction of the fresh root of couch-grass, evaporated to the consistence of new honey. Pectoral.—*Dose*, 15 gr. to ½ dr., or more.

Extract of Cu'bebs. *Syn.* EXTRACTUM CUBEBÆ, L. *Prep.* 1. From the alcoholic tincture evaporated by a very gentle heat.—*Dose*, 5 to 30 gr.

2. (*Mr Toller.*) To the last add a little powdered Castile soap, when it begins to thicken, and evaporate to a pilular consistence.—*Dose*, 10 to 30 gr.

3. (EXTRACTUM CUBEBÆ FLUIDUM; FLUID EXTRACT OF CUBEBS.) (Ph. U. S.) *a.* Cubebs in No. 60 powder are exhausted with alcohol, and the solution evaporated to an extract. The extract is dissolved in alcohol so that 1 part of the fluid shall equal 1 part of cubebs.—*Dose*, ½ to 1 dr.

b. (*M. Puche.*) From cubebs and proof spirit, equal parts, by percolation; without subsequent evaporation. Represents its own weight in cubebs.—*Dose*, ½ to 1 fl. dr.

c. (Ph. U. S. 1851.) Cubebs, 1 lb. (nearly); ether, q. s.; make 1 quart of tincture; then distil off 1½ pints of the ether by the heat of a water-bath, and expose the residuum in a shallow vessel until the remainder of the ether has evaporated.

4. (Oleo-resinous: EXTRACTUM CUBEBÆ, E. CUBEBRUM, E. C. OLEO-RESINOSUM, L.) *a.* (*M. Dublanc.*) The essential oil resulting from the careful distillation of any given quantity of cubebs, is mixed with the resinous extract obtained by evaporating a tincture of the dried residuum made with rectified spirit; the whole being reduced to the consistence of a thick syrup. 1 lb. of cubebs yields about 6 oz. of the extract.

b. (*Labelonge.*) Cubebs are first exhausted with ether, and then with proof spirit, in a displacement apparatus; the alcoholic tincture is evaporated to an extract over a water-bath, and when cold, the ethereal tincture is mixed with it, and the mixture abandoned to spontaneous evaporation until the ether is volatilised.

c. (*W. Procter.*) An ethereal tincture (by displacement) is poured into a large retort, and 5-6ths is drawn over by the heat of a water-bath; the evaporation of the residuum to the proper consistence is carried on at a heat not exceeding 120° F. The formula of the Ph. Baden is nearly similar. Said to represent 6 to 8 times its weight in cubebs. 1 lb. yields 2 oz. of this extract.

d. (Hamb. Cod. 1845.) This resembles *a* (*above*).

Obs. This extract has a darkish brown colour, and tastes and smells strongly of cubebs. It is only slightly soluble in water.—*Dose*, 5 to 20 gr.; made into an emulsion or pills, or enclosed in a capsule. See CUBEBS.

Extract of Cu'cumber. See ELATERIUM.

Extract of Cuspa''ria. *Syn.* EXTRACT OF ANGOSTURA BARK; EXTRACTUM CUSPARIÆ, E. CORTICIS C., E. ANGOSTURÆ, L. *Prep.* 1. From angostura bark, as EXTRACT OF CINCHONA (Ph. L.).

2. (Alcoholic.) As EXTRACT OF CINCHONA (Ph. E.). Stronger than the last. Both are aromatic, bitter, tonic, and stimulant.—*Dose*, 10 gr. to ½ dr.; in dyspepsia, chronic diarrhœa, dysentery, &c.

Extract of Daff'odil. *Syn.* EXTRACTUM NARCISSI, L. *Prep.* 1. From the fresh flowers of daffodil or yellow narcissus (*Narcissus pseudo-narcissus*), as EXTRACT OF ACONITE (Ph. L.).

2. (Alcoholic.) From the dried flowers, as EXTRACT OF BOX. Both are pectoral and expectorant, and in large doses nauseant and emetic.—*Dose*, ½ to 2 gr.; in hooping-cough, &c.

Extract of Dandeli'on. See EXTRACT OF TARAXACUM.

Extract of Digita'lis. See EXTRACT OF FOXGLOVE.

Extract of Dog's Grass. See EXTRACT OF COUCH-GRASS.

Extract of Dog'wood. *Syn.* EXTRACTUM CORNÛS, E. CORNI, L. *Prep.* From American or tree dogwood (*Cornus florida*), as EXTRACT OF CINCHONA BARK.

Obs. In its general effects, American dogwood approaches the cinchonas, and is said to be not inferior to them in the cure of intermittents (*Bigelow*). It contains a peculiar bitter principle, called cornine. Several other varieties of the genus *Cornus*, as round-leaved dogwood (*Cornus circinata*), swamp dogwood (*Cornus sericea*), &c., are used in America, but are less valuable.

Extracts, Dried or Powdered. *Syn.* EXTRACTA SICCI vel PULVERATA (Ph. Prus.). These are made by mixing 4 parts of the extract with 1 part of powder of sugar of milk, and setting the mixture in a warm place till dry.

Triturate the mass to powder, adding more of the sugar of milk, if necessary, to make the weight the same as the extract used. The German Pharmacopœia directs them to be mixed with dextrin, and then dried at a temperature of 122° F., and, while still warm, triturated into a uniform powder, with dextrin q. s. to make the weight of the powder equal to twice the weight of the extract employed.

Extract of Dulcama''ra. See EXTRACT OF BITTER-SWEET.

Extract of Elate'rium. *Syn.* INSPISSATED JUICE OF THE SQUIRTING CUCUMBER; SUCCUS SPISSATUS MOMORDICÆ ELATERII, L. For preparation and recent synonyms, see ELATERIUM.

Extract of El'der-berries. *Syn.* ELDER ROD; ROOB SAMBUCI, EXTRACTUM SAMBUCI, E. S. NIGRÆ, E. BACCARUM S., SUCCUS SAMBUCI INSPISSATUS, L. *Prep.* 1. (Ph. L. 1788.) The expressed and depurated juice of elder-berries, evaporated to the consistence of honey.

2. (Ph. E. 1744.) To the above, when it begins to thicken, add 1-5th part of sugar.

3. (Ph. Bor.) As the last (nearly), but adding only 1 oz. of white sugar to each pound of the extract whilst still warm.—*Dose*, 1 to 4 dr.; in rheumatism, gout, and various skin affections.

Extract of El'ecampane. *Syn.* EXTRACTUM INULÆ, E. RADICUM I. CAMPANÆ, E. HELENII, L. *Prep.* 1. (Ph. L. 1746.) From a decoction of the dried root.

2. (P. Cod.) As EXTRACT OF BISTORT (P. Cod.).

3. (Ph. Suec. 1845.) From a tincture prepared with proof spirit and water, equal parts.—*Dose*, 10 gr. to ½ dr.; as a diaphoretic, expectorant, and tonic; in asthma, hooping-cough, various skin diseases, &c.

Extract of Elm. *Syn.* EXTRACTUM ULMI, E. CORTICIS U., L. *Prep.* 1. From the decoction of the bark of the common elm (*Ulmus campestris*).

2. (*Soubeiran.*) As EXTRACT OF BOX. Astringent and alterative.—*Dose*, 20 gr. to 1 dr.; in secondary syphilis, chronic skin affections, &c.

Extract of Er'got. *Syn.* AQUEOUS EXTRACT OF ERGOT, HÆMOSTATIC EXTRACT; EXTRACTUM ERGOTÆ, E. E. AQUOSUM, E. SECALIS CORNUTI, E. HÆMOSTATICUM, L. *Prep.* 1. (B. P.) *Extractum ergotæ liquidum.* 1 lb. of crushed ergot is exhausted with cold distilled water and the liquid evaporated to 11 oz., then made up to 16 fl. oz. with rectified spirit and filtered.

2. (Alcoholic: EXTRACTUM ERGOTÆ ALCOHOLICUM, L.) See ERGOTINE (*Wigger's*).

Extract of Eucalyptus Globulus. *Syn.* EXTRACTUM EUCALYPTI GLOBULI. *Prep.* (*Griffith.*) Eucalyptus leaves cut small. Distil the volatile oil with water; exhaust the residue in the still with water, prepare an extract, exhaust this with alcohol, evaporate to the consistence of an extract, and, while cooling, stir in the volatile oil.—*Dose*, 2 to 8 gr.

Extract of Fern. *Syn.* EXTRACTUM FILICIS LIQUIDUM (B. P.). See EXTRACT OF MALE FERN.

Extract of Fleabane (Canadian). *Syn.* EXTRACTUM ERIGERONTIS. *Prep.* 1. From Canadian fleabane, by evaporating an aqueous infusion.—*Dose*, 5 to 10 gr.

2. (EXTRACTUM ERIGERONTIS CANADENSIS FLUIDUM.) (Ph. U. S.) Canadian erigeron in moderately coarse powder, 16 oz. (troy); rectified spirit, 16 oz. (old measure). Proceed as for fluid extract of cubebs (Ph. U. S.).

Extract of Flesh. See EXTRACT OF MEAT, ESSENCE OF BEEF, TEA (Beef), &c.

Extract of Foxglove. *Syn.* EXTRACTUM DIGITALIS (Ph. E.), L. *Prep.* 1. (Ph. L. 1836.) From the leaves of *Digitalis purpurea*, as EXTRACT OF ACONITE (Ph. L.).

2. (Ph. E.) From the filtered expressed juice, either evaporated *in vacuo*, with the aid of heat, or by exposure to a current of dry air.

3. (P. Cod.) *a.* As EXTRACT OF BISTORT (P. Cod.).

b. As EXTRACT OF BOX (P. Cod.).

4. (Ph. Baden.) As ALCOHOLIC EXTRACT OF ACONITE (Ph. Bad.).

Obs. The juice of foxglove is very readily injured by exposure to air and heat. The evaporation should therefore be conducted as rapidly as possible, but at a low temperature. It is narcotic, sedative, and powerfully poisonous.—*Dose*, ½ gr., cautiously increased to 2 or 3 gr. It is principally given in fevers, dropsy, diseases of the heart, pulmonary consumption, epilepsy, scrofula, and asthma. This extract spoils by long keeping. The last two are stronger than the rest, and keep better. It is omitted in the present Ph. L.

Extract of Fu'mitory. *Syn.* EXTRACTUM FUMARIÆ, L. *Prep.* 1. From either the infusion or decoction of the dried leaves of common fumitory (*Fumaria officinalis*).

2. (B. Cod.) From the clarified juice of the fresh herb. Slightly aperient, diaphoretic, and alterative. It has been given in obstructions of liver and cutaneous affections of the leprous kind.

Extract of Galls. *Syn.* EXTRACTUM GALLÆ, E. GALLARUM, L. *Prep.* 1. From the infusion by maceration or displacement with cold water.

2. From the hot infusion or decoction. The first is to be preferred. Astringent. Used chiefly in ointments and injections for piles, foul ulcers, &c., and, internally, in hæmorrhages, spitting of blood, &c.

Extractum Gelsemii Alcoholicum. ALCOHOLIC EXTRACT OF GELSEMIUM (B. P.). Made from the root *Gelsemium* in No. 60 powder, by the same process as alcoholic extract of belladonna. Used in nervous diseases, toothache, and neuralgia. —*Dose*, ½ to 2 gr.

Extract of Gen'tian. *Syn.* EXTRACTUM GENTIANÆ (B. P.), L. *Prep.* 1. (Ph. L.) Gentian root (sliced), 3 lbs.; distilled water (temperate), 4 pints; macerate for 12 hours, and gently express the liquor; repeat the maceration with water, 1 quart, for 6 hours; and evaporate the mixed liquors.

2. (Ph. L. 1836.) From the ordinary infusion of the root made with 10 or 12 times its weight of boiling water, the maceration being continued for 24 hours.

3. (Ph. E.) From an infusion prepared by percolation with cold water. The formulæ of the Ph. Baden, Paris, and U. S. are similar.

4. (B. P.) Gentian, 1 lb.; water (boiling), 10; macerate for 2 hours; boil 15 minutes, strain, and evaporate to a soft pilular consistence.—*Dose*, 10 to 15 gr.

5. (Ph. D. 1826.) From the decoction.

Obs. On the large scale this extract is almost universally prepared by exhausting the root by boiling with water, as in the last formula. When well prepared it is one of the smoothest and brightest extracts of the Pharmacopœia. Good gentian root yields by infusion in hot water fully 50%, and by decoction about 60% of extract.—

Dose, 10 gr. to 30 gr., 2 or 3 times daily, as a stomachic bitter and tonic; either alone or combined with rhubarb, ginger, or aloes. It is, however, more especially used as a vehicle for chalybeates and other metallic preparations. The principal consumption of extract of gentian is by the brewers, in lieu of hops.

6. (HARD E. OF G.; E. G. DURUM, L.) The last dried by a gentle heat until brittle enough to powder.

Extract (Fluid) of Ginger. *Syn.* EXTRACTUM ZINGIBERIS FLUIDUM (Ph. U. S.). As fluid extract of cubebs, but using rectified spirit.

Extract (Fluid) of Golden Seal. *Syn.* EXTRACTUM HYDRASTIS FLUIDUM (Ph. U. S.). *Prep.* Made from hydrastis or golden seal in No. 60 powder in the same manner as fluid extract of cubebs of the Ph. U. S.

Extract, Goulard's. See SOLUTION OF SUBACETATE OF LEAD.

Extractum Grindeliæ Liquidum (B. P. C.). *Syn.* LIQUID EXTRACT OF GRINDELIA. Take of grindelia, in No. 20 powder, 20 oz.; rectified spirit, a sufficient quantity; moisten the powder with 8 fl. oz. of the spirit, pack it tightly in a percolator, and pour on sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop, close the lower orifice and macerate for 48 hours; then allow percolation to proceed, gradually adding menstruum until the grindelia is exhausted. Reserve the first 17 fl. oz. of the percolate, distil off the spirit from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the liquid extract measure 1 pint.—*Dose*, 10 to 30 minims.

Extract of Guai'acum. *Syn.* EXTRACTUM GUAIACI, L. *Prep.* 1. (Ph. L. 1746.) From lignum vitæ shavings or sawdust, exhausted by coction with water; as soon as the mass becomes thick, 1-8th of rectified spirit is to be added.

2. As the last, omitting the spirit. Diaphoretic, diuretic, and alterative; in dropsy, gout, rheumatism, skin diseases, &c.

Extract of Guarana. *Syn.* EXTRACTUM GUARANÆ, E. PAULLINIÆ, L. *Prep.* (*Dr Gavrelle.*) From tincture of guarana (seeds of *Paullinia sorbilis*), prepared by coction with proof spirit. Tonic and alterative.—*Dose*, 2 to 5 gr., twice or thrice daily.

Extract, Hæmostat'ic. See EXTRACT OF ERGOT.

Extractum Hamamelidis Liquidum (B. P. C.). LIQUID EXTRACT OF HAMAMELIS. Take of hamamelis leaves, in No. 40 powder, 20 oz.; rectified spirit, distilled water, of each a sufficient quantity; moisten the powder with 8 fl. oz. of a mixture of 1 volume of rectified spirit and 2 volumes of distilled water, pack it tightly in a percolator, and pour on sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop, close the lower orifice and macerate for 48 hours; then allow percolation to proceed, gradually adding menstruum until the hamamelis is exhausted. Reserve the first 17 fl. oz. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the liquid extract measure 1 pint.—*Dose*, 2 to 5 minims.

Extract of Hedge Hyssop. *Syn.* EXTRACTUM GRATIOLÆ, L. *Prep.* 1. (Ph. Bor.) From the herb (*Gratiola officinalis*), as ALCOHOLIC EXTRACT OF ACONITE (Ph. Bor.).

2. (Ph. Baden.) As EXTRACT OF ACONITE (Ph. Baden).

3. (Vinous.) As VINOUS EXTRACT OF CINCHONA. Purgative, diuretic, and vermifuge.—*Dose*, 2 to 5 gr., gradually increased, watching its effects; in dropsy, jaundice, gout, &c. It has been said to be the basis of the celebrated 'EAU MÉDICINALE D'HUSSON.'

Extract of Hel'lebore. The extracts prepared from three different plants may be included under this head:

1. (EXTRACT OF BLACK HELLEBORE; EXTRACTUM HELLEBORI, E. H. NIGRI, L.) *a.* (Ph. L. 1788.) From the infusion or decoction of black hellebore (*Helleborus officinalis*).—*Dose*, 5 to 12 gr.

b. (Alcoholic: P. Cod. & Ph. U. S.) As EXTRACT OF BOX (nearly). That of the Ph. Bad. is similar.—*Dose*, 3 to 8 gr.

c. (Vino-alcoholic: *Cottereau.*) Powdered black hellebore, 2 lbs.; salt of tartar, ½ lb.; dilute alcohol (sp. gr. ·935), 7 pints; digest 12 hours and express the tincture; add to the marc white wine, 7 pints; digest for 24 hours, express, mix the tincture, filter, and evaporate.—*Dose*, 2 to 6 gr.

Obs. When prepared by coction with water till exhausted of soluble matter, black hellebore root yields about 40% of extract. In small doses it is alterative, purgative, and resolvent; in larger ones it is a drastic, hydragogue cathartic, and emmenagogue, dangerous unless combined and its effects carefully watched.

2. (EXTRACT OF GREEN HELLEBORE, E. OF AMERICAN H., E. OF ITCH-WOOD; EXTRACTUM VERATRI VIRIDIS, L.) From the fresh root (rhizome) of the green hellebore (*Veratrum viride*), as EXTRACT OF ACONITE (Ph. L.).—*Dose*, ⅙ to ½ gr. Used in America in the same cases as white hellebore.

3. (EXTRACT OF WHITE HELLEBORE; EXTRACTUM VERATRI, E. HELLEBORI ALBI, L.) From the root (rhizome) of the white hellebore (*Veratrum album*), as EXTRACT OF BLACK HELLEBORE.—*Dose*, $\frac{1}{12}$ to ¼ gr. Emetic, purgative, stimulant, and highly acrid. In gout, rheumatism, and nervous affections, mania, &c. See VERATRINE.

Extract of Hem'lock. *Syn.* INSPISSATED JUICE OF HEMLOCK; EXTRACTUM CONII (B. P.), SUCCUS SPISSATUS CONII, L. *Prep.* 1. (B. P.) The inspissated juice of the fresh plant, prepared as directed for EXTRACTUM BELLADONNÆ.—*Dose*, 4 to 6 gr.

2. (Ph. L.) From the fresh plant (*Conium maculatum*), as EXTRACT OF ACONITE (Ph. L.).

3. (Ph. E.) As EXTRACT OF FOXGLOVE (Ph. E.).

4. (Ph. D.) As EXTRACT OF BELLADONNA (Ph. D.).

Obs. Of all the inspissated juices (not even excepting that of aconite) this is the one most readily injured by exposure to the air and heat, and which soonest loses its qualities by age. Its active principle is CONINE. Extract of hemlock has a greenish colour and a strong odour of the

fresh-bruised plant. It is "of good quality only when a very strong odour of conia (a 'mouse-odour') is disengaged by degrees on its being carefully triturated with liquor of potassa" (P. E.). "The extracts of hemlock may become feeble, if not inert, in one of two ways—either by the heat being continued after the concentration has been carried to a certain extent, or by long keeping. On the one hand, I have always observed that from the point at which the extract attains the consistence of thin syrup ammonia begins to be given off in abundance, together with a modified odour of conine; and, on the other hand, I have found extracts which were unquestionably well prepared at first, entirely destitute of conine in a few years" (*Christison*). "The most active extract is that which is procured by moderate pressure from the leaves only" (*Brande*). "The extract of the Ph. D., being freed from the inert albumen and chlorophyll, contains most of the active principle, and is nearly soluble in water" (*Royle*). On the large scale the whole of the green portion of the plant is pressed for juice. 1 cwt. of hemlock yields from 3 to 5 lbs. of extract.—*Dose*, 2 gr., gradually increased to 5 gr., or more, until some obvious effect is produced; as an anodyne and antispasmodic in chorea and nervous affections, and resolvent in various obstinate disorders, as glandular and visceral enlargements, foul and painful ulcers, scrofula, cancer, neuralgia, rheumatism, troublesome coughs, &c.

5. (Alcoholic: EXTRACTUM CONII ALCOHOLICUM, L.) *a.* (Ph. Baden.) As ALCOHOLIC EXTRACT OF ACONITE (Ph. Baden).

b. (P. Cod.) As the last, but using proof spirit.—*Dose*, ½ to 2 gr.

6. (Dried: EXTRACTUM CONII SICCUM, L.) *a.* As the DRIED EXTRACT OF ACONITE (P. Cod.).

b. (*Archer.*) By drying the extract of the Dublin College with a continuous current of warm air.

7. (EXTRACTUM CONII SEMINIS ALCOHOLICUM.) (P. Cod.) *Prep.* Hemlock seeds in coarse powder, 1 lb.; percolate with proof spirit until exhausted. Distil off most of the spirit, and evaporate residue in a water-bath to pilular consistence.

Extract of Hemp. *Syn.* EXTRACT OF AMERICAN HEMP; EXTRACTUM APOCYNI, E. A. CANNABINI, L. *Prep.* From the root of the *Apocynum cannabinum*, as EXTRACT OF GENTIAN. A hydragogue cathartic.—*Dose*, 2 to 6 gr.; in dropsy, &c. The plant from which this extract is prepared is called 'Indian HEMP' in the United States of America, a practice which should be avoided, as this name is now almost exclusively appropriated to *Cannabis indica*, a variety of the common hemp (*Cannabis sativa*, var. *indica*) growing in India. See EXTRACT OF INDIAN HEMP.

Extract of Hen'bane. *Syn.* EXTRACT OF HYOSCYAMUS; EXTRACTUM HYOSCYAMI (B.P.), SUCCUS SPISSATUS HYOSCYAMI, L. *Prep.* 1. (Ph. L.) From the fresh leaves and leaf-stems of common henbane (*Hyoscyamus niger*), as EXTRACT OF ACONITE (Ph. L.).

2. (Ph. E.) As EXTRACT OF FOXGLOVE (Ph. E.).

3. (Ph. P.) From the fresh leaves and young branches, as EXTRACT OF BELLADONNA.—*Dose*, 3 to 6 gr.

4. (Ph. U. S.) From the expressed juice coagulated by heat and strained.

Obs. In the Paris Codex extracts are ordered to be prepared from henbane both by the processes Nos. 1 and 4 above.—*Prod.* (by the ordinary method). 1 lb. of the fresh leaves yielded fully 8 dr. of extract (*Geiger*); 1 cwt. yielded 4 to 5 lbs. (*Brande*); 1 cwt. of the recent plant yielded, by an ordinary screw press, 59½ lbs. of juice, and this evaporated in a water-bath gave 5 lbs. 9 oz. of extract (*Squire*); 1¾ cwt. of the green herb yielded 11 lbs. of extract (*Gray*).—*Dose*, 2 to 10 gr.; as an anodyne, hypnotic, antispasmodic, sedative, and narcotic, more especially in those cases in which the use of opium is objectionable.—*Externally*, as a topical application to sore or inflamed parts, either made into an ointment or spread on plaster.

5. (Alcoholic: EXTRACTUM HYOSCYAMI ALCOHOLICUM, L.) The formulæ of the Ph. Bad., Par., & U. S. are similar to those for ALCOHOLIC EXTRACT OF ACONITE.

6. (E. OF HENBANE SEEDS; EXTRACTUM SEMINUM HYOSCYAMI, L.) (P. Cod.) An extract of the seeds made with spirit (sp. gr. ·900 = about 16 o. p.) is dissolved in 4 parts of cold water, and the solution filtered and evaporated. Stronger than the simple extract.—*Dose*, ¼ to 3 gr.

Extract of Ho'ly This'tle. *Syn.* EXTRACTUM CARDUI BENEDICTI, L. *Prep.* 1. (Ph. Baden.) From holy or blessed thistle (*Carduus benedictus*) by displacement with cold water.

2. (Ph. Bor.) As EXTRACT OF GENTIAN, Ph. L. (nearly). Tonic, diaphoretic, febrifuge, often diuretic, and occasionally emetic.—*Dose*, 5 to 15 gr., as a tonic or stomachic chiefly.

Extract of Hops. *Syn.* EXTRACTUM LUPULI (B. P.), Ph. L. & E.), E. HUMULI (Ph. D.), L. *Prep.* 1. (B. P.) Hop, 8; rectified spirit, 15; distilled water, 80. Macerate the hop in the spirit for 7 days, press out the tincture, filter, and distil off the spirit, leaving a soft extract; boil the residual hop with the water for one hour, then express the liquor, strain, and evaporate on a water-bath to the consistence of a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 160° to a pilular consistence.—*Dose*, 5 to 10 gr.

2. (Ph. L.) From commercial hops (the strobiles or catkins of *Humulus lupulus*), 2½ lbs.; boiling distilled water, 2 galls.; macerate for 24 hours, boil to a gallon, strain whilst hot, and evaporate to a proper consistence. The form of the Ph. E. is nearly similar.

3. (Ph. D.) As EXTRACT OF ALOES (Ph. D.). Tonic and stomachic, and slightly anodyne and hypnotic.—*Dose*, 5 to 30 gr.; in dyspepsia and cases that do not permit of the use of opium. 1 cwt. of ordinary hops yields about 40 lbs. of extract (*Brande*). The druggists usually employ hops 2 or more years old, called by the dealers 'yearlings,' 'olds,' or 'old olds,' because these may be purchased at ⅔ to ½ the price of those of the last season's growth. The first of the above are estimated to have only ⅔ the strength of new hops; the second about ½; and the last little or none, at least from a medical point of view.

4. (Alcoholic: EXTRACTUM LUPULI ALCOHOLICUM, L. *Cottereau.*) By displacement with

proof spirit. Stronger than the aqueous extract.

Extract of Hore'hound. *Syn.* EXTRACTUM MARRUBII, L. *Prep.* 1. From the fresh herb, as EXTRACT OF ACONITE.

2. From the infusion or decoction. Antispasmodic, pectoral, tonic, and emmenagogue.—*Dose,* 10 gr. to 1 dr.

3. (Ph. Baden.) By displacement with cold water.

4. (Alcoholic: EXTRACTUM MARRUBII ALCOHOLICUM, L.) *a.* From a tincture made with proof spirit. Said by M. Thoriel to possess considerable power as a febrifuge.—*Dose,* 5 to 20 gr.

b. (Ph. Lusit.) From a tincture made with a mixture of rectified spirit, 1 part, and water, 7 parts. Inferior to the last.

Extract of In'dian Hemp. *Syn.* CANNABINE, HEMP RESIN, ALCOHOLIC EXTRACT OF INDIAN HEMP; EXTRACTUM CANNABIS INDICÆ, E. C. I. ALCOHOLICUM, RESINA CANNABIS, L. *Prep.* 1. (B. P.) Indian hemp in coarse powder, 1; rectified spirit, 5; macerate 7 days, press out the tincture, distil off the spirit, and evaporate.—*Dose,* ¼ to 1 gr. in pill.

2. (*O'Shaughnessy.*) The dried resinous tops of Indian hemp ('GUNJAH') are boiled in rectified spirit until all the resin is taken up, when most of the spirit is distilled off, and the evaporation completed by the heat of a water-bath. 1 cwt. yields about 7 lbs.

3. (*Robertson.*) By slowly acting on the 'gunjah' with the vapour of alcohol, by a species of percolation; the spirit of the resulting tincture is partly removed by distillation, and the rest by slow evaporation at a temperature not above 150° F. 1 cwt. yields about 8 lbs.—*Dose.* Of the last two, 1 to 3 gr., gradually increased.

4. (*Messrs Smith.*) The bruised 'gunjah' is exhausted with tepid water, then with a solution of carbonate of soda (1 of carbonate to 2 of gunjah), and next with pure water; it is then pressed, dried, and exhausted by displacement with rectified spirit; the tincture is agitated with a milk of lime (containing 1 oz. of lime for every lb. of gunjah), and, after filtration or decantation, any retained lime is precipitated by a little sulphuric acid in slight excess; the tincture is next agitated with animal charcoal, and again filtered; most of the spirit is now removed by distillation, and 3 or 4 times its bulk of water being added, the remaining spirit is removed by a gentle heat; lastly, the remaining water is poured of, and the resin remaining washed with fresh water, and dried. *Prod.,* 6%. Commencing dose, ¼ gr.

5. (Purified: EXTRACTUM CANNABIS INDICÆ PURIFICATUM, L.) (Ph. D.) From the crude extract of Indian hemp, as imported ('CHURRUS'), 1 oz.; rectified spirit, 4 fl. oz.; dissolve, and after defæcation, decant and evaporate.

Obs. The preparations of Indian hemp are said to be anæsthetic, anodyne, hypnotic, stimulant, phrenic, and aphrodisiac, and, in overdoses to produce catalepsy. They have been recommended in hysteria, hydrophobia, cholera, rheumatism, chorea, convulsions, and various other painful spasmodic and nervous affections of a serious character. According to the observations of Dr O'Shaughnessy, 1 gr. of the extract produced catalepsy in a rheumatic patient. The extract prepared with the plant grown in our botanic gardens has quite a different effect from that of the Indian plant; and it also appears that the inhabitants of this country are less susceptible to its action than those of India, and consequently bear the drug in larger doses. This hemp is known in India as the 'increaser of pleasure,' the 'exciter of desire,' the 'cementer of friendship,' the 'causer of a reeling gait,' the 'laughter-mover,' &c. See EXTRACT OF HEMP (*above*), HEMP, &c.

Extract of Ipecacuan'ha. *Syn.* EXTRACTUM IPECACUANHÆ, L. *Prep.* 1. (P. Cod.) From ipecacuanha, as EXTRACT OF BOX (P. Cod.).

2. (Ph. Bor.) As EXTRACT OF HENBANE SEEDS. Expectorant and emetic.—*Dose,* 1½ to 8 gr.

Extract of I'ron. *Syn.* EXTRACTUM FERRI, E. MARTIS, L. *Prep.* 1. From tincture of tartarised iron.—*Dose,* 2 to 10 gr., as a chalybeate tonic.

2. (Compound.) See EXTRACT OF APPLE.

Extractum Jabor'andi. EXTRACT OF JABORANDI (B. P.). 1 lb. of jaborandi leaves in No. 40 powder are exhausted with proof spirit, and the fluid evaporated to a suitable consistence.

Extract of Jabor'andi (Fluid). (*F. V. Greene,* 'Amer. Journ. Pharm.,' 1877.) *Prep.* Jaborandi leaves in moderately fine powder, 16 troy oz.; alcohol (50%), a sufficient quantity. Moisten the powder thoroughly with the menstruum, pack in a conical glass percolator, place a layer of 2 inches of well-washed sand on the top of the cloth covering the material, add menstruum until the liquid begins to drop from the percolator, when the lower orifice is to be closed with a cork, and the percolator securely covered; set aside in a moderately warm place for 4 days. At the expiration of this time remove the cork, and add more menstruum by degrees until the material is exhausted. The first 14 oz. (old measure) of the percolate are to be reserved, and the remainder evaporated on a water-bath, with constant stirring towards the close, to 2 fl. oz. (old measure), which are to be added to the reserved portion. If the percolation and evaporation have been properly performed the fluid extract will not require to be filtered.

Extract of Jal'ap. *Syn.* EXTRACTUM JALAPÆ (B. P.), E. SIVE RESINA JALAPÆ (Ph. E.), L. *Prep.* 1. (B. P.) Jalap in coarse powder, 1; rectified spirit, 5; distilled water, 10; macerate the jalap in the spirit for 7 days, press out the tincture, then filter, and distil off the spirit, leaving a soft extract; again macerate the residual jalap in water for 4 hours, express, strain through flannel, and evaporate by a water-bath to a soft extract; mix the two extracts, and evaporate at a temperature not exceeding 140° F. to a proper consistence for forming pills.—*Dose,* 5 to 15 gr.

2. (Ph. L.) Jalap (powdered), 2½ lbs.; rectified spirit, 1 gall.; digest 4 days, and express the tincture; boil the 'marc' in water, 2 galls., until reduced to ½ gall.; filter the tincture and decoction separately, and let the one distil and the other evaporate until each thickens; lastly, mix the two and complete the evaporation.—*Prod.* About 66% = 16% of alcoholic and 50% of aqueous extract (*Brande*). 18 lbs. yield 12 lbs. of extract ('Lab. Journ.').—*Dose,* 6 to 15 gr.

3. (Ph. E.) From tincture of jalap prepared by displacement with rectified spirit. It consists of impure resin of jalap. It is more active than the last. *Prod.*, 16%.—*Dose*, 2 to 6 gr.

4. (Ph. Ed. 1744: EXTRACTUM JALAPÆ ALKALINUM.) As extract jalap (B. P.), adding for every pound of jalap, 1 oz. or q. s. of carbonate of potash.

Obs. Extract of jalap is an active purgative. It should be well beaten up with a little sulphate of potassa, sugar, or some aromatic powder to prevent it griping. The substance commonly sold as extract of jalap in the shops is prepared by boiling jalap root for 3 or 4 hours in water, when it is taken out, and well bruised or sliced, and again boiled with water until exhausted of soluble matter. The mixed decoctions are then allowed 12 or 14 hours for defæcation, after which the supernatant portion is decanted and evaporated.

Extract of jalap "should be kept in the soft state (EXTRACTUM JALAPÆ, E. J. MOLLE), so as to form pills; and in the hard state (HARD EXTRACT OF JALAP; EXTRACTUM JALAPÆ DURUM), that it may be rubbed to powder" (Ph. L.).

Extract of Ju'niper. *Syn.* EXTRACTUM JUNIPERI, E. BACCARUM J., L. *Prep.* (P. Cod.) Macerate juniper berries in water at 77°—86° F. for 24 hours, strain, repeat the process with a fresh quantity of water, mix the liquors, filter, and evaporate.—*Dose*, 20 gr. to 1 dr.; as a stimulant diuretic, in dropsy, &c.; and also as a pill basis.

Extract of Kalada'na. *Syn.* EXTRACTUM KALADANÆ, L. *Prep.* (Bengal Disp.) From the tincture of the seeds of kaladana (*Pharbitis nil*). Purgative, said to be equal to EXTRACT OF JALAP, and of double the strength.

Extract of Lettuce. *Syn.* INSPISSATED JUICE OF LETTUCE; EXTRACTUM LACTUCÆ (B. P.), L. *Prep.* 1. (B. P.) The inspissated juice evaporated to a pilular consistence, according to the directions given for EXTRACTUM BELLADONNÆ.

2. (Ph. L.) From the fresh leaves of garden lettuce (*Lactuca sativa*), as EXTRACT OF ACONITE (Ph. L.). Anodyne, sedative, hypnotic, and antispasmodic.—*Dose*, 3 to 10 gr. 1 cwt. of lettuce yields 4 to 5 lbs. of extract.

3. (*Probait.*) From the external parts of the stalks and the old and yellow leaves, after the plants have flowered, by maceration in water for 24 hours, and decoction for 2 hours; the expressed liquid is first evaporated by a gentle heat, and afterwards spread on shallow dishes, and dried by exposure to a current of air. Stronger than the last.—*Dose*, 1 to 5 gr.

4. (E. OF WILD LETTUCE, INSPISSATED JUICE OF W. L.; EXTRACTUM LACTUCÆ VIROSÆ, SUCCUS SPISSATUS L. V., Ph. E., L.) *a.* (Ph. E.) From the leaves of strong-scented wild lettuce (*Lactuca virosa*) (see general instructions).

b. (P. Cod.) As ALCOHOLIC EXTRACT OF ACONITE (P. Cod.).

c. (Ph. Baden.) As EXTRACT OF FOXGLOVE (Ph. Baden). See LACTUCARIUM.

Extract of Liq'uorice. *Syn.* EXTRACTUM GLYCYRRHIZÆ (B. P.), L. *Prep.* 1. (SOFT E. OF L.; EXTRACTUM GLYCYRRHIZÆ MOLLE, L.) *a.* (Ph. L.) From fresh liquorice root, as EXTRACT OF HOPS (Ph. L.).

b. (Ph. E.) From the fresh root, cut into slices, dried, and powdered, as EXTRACT OF GENTIAN (Ph. E.). The form of the Ph. Baden is very similar.

c. (Ph. D.) As ordered for simple extracts (EXTRACTA SIMPLICIORA, Ph. D.).

d. (B. P.) Liquorice root in coarse powder, 1; cold distilled water, 5; macerate the root in half the water for 12 hours, strain, and press; again macerate the pressed marc with the remainder of the water for 6 hours, strain and press, mix the strained liquors, heat to 212° F., strain, and evaporate to a pill consistence.—*Dose*, ½ to 1 dr.

e. (B. P.: EXTRACTUM GLYCYRRHIZÆ LIQUIDUM.) *Prep.* Liquorice root in coarse powder, 1 lb.; distilled water, 4 pints. Macerate the liquorice with 2 pints of water for 12 hours, strain, and press; again macerate the pressed marc with the remainder of the water for 6 hours, strain, and press. Mix the strained liquors, heat to 212° F., and strain through flannel; then evaporate by a water-bath until it has acquired, when cold, a sp. gr. of 1·160; add to this 1-8th of its volume of rectified spirit; let the mixture stand for 12 hours and filter.

f. (U. S. Disp.) Crude liquorice (SPANISH JUICE), q. s., is dissolved in water, and the solution filtered and evaporated. To produce a good article (EXTRACTUM GLYCYRRHIZÆ PURIFICATUM) in this way, the solution should be allowed some hours for defæcation, and should not be decanted and strained until quite cold.

Obs. Soft extract of liquorice is often employed as a pill basis, and the hard extract (SPANISH JUICE, &c.) is used as a lozenge to allay tickling cough. The principal portion of the latter is, however, consumed by the porter brewers and brewers' druggists. The product of the last formula, evaporated until it is quite solid when cold, and made into small pipes, stick, or rolls, forms the BEST REFINED LIQUORICE or REFINED JUICE of the shops.

2. (HARD E. OF L., SPANISH JUICE, S. LIQUORICE, GLYCYRRHIZIN, BLACK SUGAR; EXTRACTUM GLYCYRRHIZÆ SIMPLEX, E. G. DURUM, SUCCUS G., S. G. SPISSATUS, L.) This is seldom prepared by the English druggists, being principally imported in the dry state from Spain and Italy. That from Solazzi (SOLAZZI JUICE) is the most esteemed. A great deal of the foreign extract is mixed with fecula, or the pulp of plums, hence its inferior quality. It also frequently contains copper, derived from the boilers in which it is prepared. The extract prepared from the fresh root is usually preferred to the best foreign, as the latter has a less sweet and agreeable taste. REFINED JUICE is prepared by dissolving the foreign juice in water, filtering and evaporating. See LIQUORICE, and *above*.

Extract of Lobe'lia. *Syn.* ACETIC EXTRACT OF INDIAN TOBACCO; EXTRACTUM LOBELIÆ, E. L. INFLATÆ, L. *Prep.* (*W. Procter.*) Lobelia seeds (bruised), 8 oz.; dilute alcohol (sp. gr. ·935), 4 pints; acetic acid, 1 fl. oz.; by maceration for 24 hours, and subsequent displacement. Expectorant and diaphoretic, in small doses; emetic and narcotic, in larger ones. It is principally used in asthma and other chest diseases.—*Dose*, ¼ to 5 gr.

Extract of Log'wood. *Syn.* EXTRACTUM

HÆMATOXYLI (B. P.), E. H. CAMPECHIANI (Ph. E.), L. *Prep.* 1. (B. P.) Logwood in chips, 1; boiling distilled water, 10; macerate 24 hours; boil to 5, strain, and evaporate to an extract, but not in iron vessels.

2. (Ph. L.) From cut logwood (logwood chips), as EXTRACT OF HOPS (Ph. L.).

3. (Ph. E.) As the last (nearly).

4. (Ph. D. 1826, and Wholesale.) From the decoction.

Obs. The Ph. U. S. 1841 orders the wood to be rasped. The Ph. Baden directs displacement with cold water. On the large scale, this extract is prepared solely by decoction. 1 cwt. of wood yields about 20 lbs. of extract (*Brande*); 80 lbs. yield 14 lbs. of extract (*Gray*). It is kept in two states—hard (EXTRACTUM HÆMATOXYLI DURUM) and soft (E. H. MOLLE). The dose of the first is 10 to 20 gr., dissolved in wine, or any cordial water; as an astringent after each motion in diarrhœa. The second is often employed as a lozenge in the same disease, and is an inexpensive and agreeable remedy for simple relaxation of the bowels.

Extract of Lo′vage. *Syn.* EXTRACTUM LEVISTICI, L. *Prep.* (Ph. Baden.) From lovage (*Levisticum officinale*), as EXTRACT OF BISTORT (P. Cod.). Aromatic, stomachic, and diaphoretic. —*Dose,* 5 to 15 gr.

Extract of Lu′puline. *Syn.* EXTRACTUM LUPULINÆ, L. *Prep.* 1. From lupuline (the powder, separated from hops by rubbing and sifting), by infusion in cold water, or by displacement.

2. (EXTRACTUM LUPULINÆ COCOTIONE PARATUM.) From the decoction. Both similar to extract of hops, but stronger. The first is the most aromatic; the last the most bitter.

Extract of Mad′der. *Syn.* EXTRACTUM RUBIÆ, L. *Prep.* (Ph. Hamb.) From the tincture of dyer's madder (*Rubia tinctorum*), made with rectified spirit, 1 part, and water, 3 parts.—*Dose,* 10 gr. to 30 gr.; as a diuretic, emmenagogue, and parturifacient; and in jaundice, &c.

Extract of Mahog′any. *Syn.* EXTRACTUM SWIETENIÆ, L. From the chips and sawdust of mahogany (*Swietenia mahogoni*). It is astringent, and is frequently sold for kino. It is also employed in tanning.

Extract of Male Fern. *Syn.* ALCOHOLIC EXTRACT OF MALE FERN; EXTRACTUM FILICIS (B. P.). *Prep.* 1. (*Dr Ebers.*) From the tincture of the dried root of male fern (*Lastræa filix-mas*), made with rectified spirit. In tapeworm.—*Dose,* 20 gr. to ½ dr., twice a day, made into an electuary with powdered sugar, and followed by a strong dose of castor oil.

2. (Ethereal: EXTRACTUM FILICIS LIQUIDUM, B. P.) Fern root, in coarse powder, 1; ether, 2½, or a sufficiency. Pack closely in a percolator with 1 of the ether, add the rest at intervals until it passes through colourless, distil off the ether, and the liquid extract remains.—*Dose,* 30 to 60 minims. See OIL OF MALE FERN.

Extract of Malt. *Syn.* EXTRACTUM MALTI, E. BYNES, L. *Prep.* 1. From the infusion made with water at a temperature ranging between 160° and 170° F., drained off, without pressure, and evaporated to the consistence of honey. Nutritious and laxative.—*Dose.* A table-spoonful, or more, *ad libitum.*

2. EXTRACT OF MALT, FERRATED. (Ph. G.) Extract of malt, 47½ oz., mixed with 1 oz. of pyrophosphate of iron and citrate of ammonia, dissolved in 1½ oz. of water.

Extractum Malti Fluidum. FLUID EXTRACT OF MALT. Malt, 16 troy oz.; alcohol, water, each a sufficient quantity.

Reduce the malt to a coarse powder, not finer than No. 20. Moisten it with 8 fl. oz. of a mixture of 1 volume of alcohol and 3 volumes of water, and set it aside, well covered, until it has ceased to swell. Then mix it with as much of the menstruum as it will take up without dripping, pack it uniformly, but without pressure, in a percolator, and add enough of the before-mentioned menstruum to cover it. When the liquid begins to drop from the orifice close the latter, and allow the contents to macerate during 24 hours, adding from time to time more menstruum, if necessary, to keep the malt just covered. Then remove the cork and allow the percolation to proceed until the percolate weighs 12 troy oz. Set this aside, well corked, until any suspended matters have been deposited. Then decant the clear liquid and preserve it for use.

Note. The product thus obtained may be regarded as being practically equivalent to the drug in the proportion of minim for grain, the apparent excess of dissolved matters present in the first portion of the percolate being about offset by the soluble matters still remaining in the drug when the percolation is interrupted ('Chemist and Druggist').

Extract of Ma″rygold. *Syn.* EXTRACTUM CALENDULÆ, L. *Prep.* 1. (*Guibourt.*) By maceration of the herb and flowers of the common marygold (*Calendula officinalis*) in tepid water for 24 hours, and subsequent coction for 15 to 20 minutes.

2. (Ph. Baden.) As EXTRACT OF ANGELICA (Ph. Baden).—*Dose,* 2 to 10 gr.; cordial, diaphoretic, alterative, and emmenagogue; in dyspepsia, and scirrhous and cancerous affections.

Extract of May-apple. *Syn.* EXTRACTUM PODOPHYLLI, L. *Prep.* (Ph. U. S. 1841.) From the tincture of the root (rhizomes) of may-apple (*Podophyllum peltatum*).—*Dose,* 5 to 15 gr.; as a substitute for extract of jalap. See PODOPHYLLIN.

Extract of Mea′dow Saf′fron. See EXTRACT OF COLCHICUM.

Extract of Meat. EXTRACT OF FLESH; EXTRACTUM CARNIS, L. *Prep.* (*Liebig.*) The lean of recently killed meat (chopped very small), 1 part; cold water, 8 parts; agitate it well together for 10 minutes; then heat it gradually to the boiling-point, let it simmer gently for a few minutes, and strain through a hair-sieve whilst still hot; lastly evaporate to a soft mass. 1 lb. of meat yields barely 1 oz. See ESSENCE OF BEEF, BEEF TEA, &c.

Extract of Meze′re′on. *Syn.* MEZEREON RESIN; EXTRACTUM MEZEREI, RESINA MEZEREI, L. *Prep.* 1. (Alcoholic: E. M. ALCOHOLICUM, L.) *a.* (Ph. Hamb.) By distilling off 5-8ths of the tincture made with rectified spirit, and fil-

tering the residue, retaining what is left on the filter.

b. By the simple distillation of the tincture.

Obs. Green or brownish green; insoluble in water. ½ oz. mezereon root-bark yielded 1½ oz. (Hamb. Disp.). It is chiefly used in preparing blistering ointments and plasters.

2. (Ethereal: GREEN OIL OF MEZEREON; EXTRACTUM MEZEREI ÆTHEREUM, B. P.) *a.* (B. P.) Mezereon bark cut small, 1 lb.; rectified spirit, 8 pints; ether, 1 pint. Macerate the mezereon in 6 pints of the spirit for 3 days, with frequent agitation; strain and press. To the residue of the mezereon add the remainder of the spirit, and again macerate for 3 days, with constant agitation; strain and press. Mix and filter the strained liquors, recover the greater part of the spirit by distillation, evaporate what remains to the consistence of a soft extract; put this in a stoppered bottle with the ether and macerate for 24 hours, shaking them frequently; decant the ethereal solution, recover part of the ether by distillation, and evaporate what remains to the consistence of a soft extract.

b. (Ph. Bor.) By digesting alcoholic extract of mezereon in ether for some days with agitation, reducing the tincture to 1-4th by careful distillation, and evaporating the residuum by a gentle heat to the consistence of an extract.

c. (Ph. U. S.: EXTRACTUM MEZEREI FLUIDUM.) Mezereon in moderately coarse powder, 16 oz. (troy); alcohol (·817), 16 oz. (old measure); proceed as for fluid extract of cubebs (Ph. U. S.).

Obs. Both the alcoholic and ethereal extract of mezereon mnst be kept in stoppered bottles. The latter, like the former, is used as an external irritant.

Extract of Mil′foil. *Syn.* EXTRACTUM MILLEFOLII, E. ACHILLÆ M., L. *Prep.* From the herb milfoil or yarrow (*Achillea millefolium*), as EXTRACT OF HOPS (Ph. L.). Astringent, tonic, and alterative.—*Dose,* 10 gr. to ½ dr.

Extract of Mimo′sa Bark. *Syn.* EXTRACTUM CORTICIS MIMOSÆ, L. *Prep.* From the bark of several Australian species of acacia or mimosa (*Acacia mollissima, A. decurrens, A. melanoxylon,* &c.). It is chiefly imported from Van Diemen's Land. Astringent. Said to be superior to oak bark for tanning.

Extract of Mone′sia Bark. *Syn.* EXTRACTUM MONESIÆ, E. M. PURIFICATUM, L. *Prep.* From the monesia or buranheim bark (bark of *Chrysophyllum baranheim*); or from commercial monesia, as EXTRACT OF CATECHU. Astringent.—*Dose,* 4 to 8 gr.

Extract of Mug′wort. *Syn.* EXTRACTUM ARTEMISIÆ, L. *Prep.* From the tops of the common mugwort (*Artemisia vulgaris*), as EXTRACT OF BOX (P. Cod.). An active emmenagogue.

Extract of Myrrh. *Syn.* EXTRACTUM MYRRHÆ, L. *Prep.* 1. (Aqueous: EXTRACTUM MYRRHÆ AQUOSUM, L.) *a.* From the strained decoction.

b. (Ph. Bor.) As EXTRACT OF ALOES (Ph. Bor.), afterwards reducing it to a fine powder. The formula of the Ph. Baden is similar.—*Dose,* 6 to 15 gr., or more.

2. (Alcoholic: RESIN OF MYRRH; EXTRACTUM MYRRHÆ ALCOHOLICUM, E. M. RESINOSUM, L.) From the tincture. Tonic and stimulant.—*Dose,* 5 to 10 gr., or more.

3. (Compound: EXTRACTUM MYRRHÆ COMPOSITUM, L. *Swediaur.*) Myrrh, 2 oz.; gum-arabic (in powder), 2 dr.; triturate, add water, q. s. to form a thick emulsion, and add extract of couch-grass, 4 oz. Much recommended in phthisis and uterine ulcerations.—*Dose,* 1 to 2 dr. in water, twice or thrice daily.

Extracts, Narcotic, with Sugar. *Syn.* EXTRACTUM NARCOTICA CUM SACCHARO. (*Guager.*) *Prep.* Dissolve 6 oz. of alcoholic extract of the plant in 14 dr. or 2 oz. of strong alcohol by trituration in a porcelain mortar, and mix with it 30 oz. of powdered white sugar, gradually added, with constant stirring. Set the mixture in a warm situation until dry. Add sugar, q. s. to make up 36 oz. These preparations are less liable to lose their efficacy than the simple extracts. 6 gr. represent one of the extract.

Extract of Net′tles. *Syn.* EXTRACTUM URTICÆ, L. *Prep.* (P. Cod.) From the juice of nettles (*Urtica dioica*), as EXTRACT OF ACONITE (Ph. L.). Antiscorbutic, diuretic, and narcotic.

Extract of Nose′gay. *Syn.* ESSENCE OF NOSEGAY; EXTRAIT DE BOUQUET, Fr. *Prep.* Flowers of benzoin, 1 dr.; essence of ambergris, 2 fl. oz.; spirits of jasmine and extract (*esprit*) of violets, of each, 1 pint; spirits of cassia, roses, orange flowers and gillyflowers, of each, ½ pint; mix. A delightful perfume.

Extractum Nucis Vom′icæ. *Syn.* EXTRACT OF NUX VOMICA. *a.* (B. P.) Made by the exhaustion of powdered nux vomica seed with a mixture of rectified spirit and water. The extract obtained is standardised, so that 100 gr. shall contain 15 gr. of the mixed alkaloids, strychnia, and brucia. For the details of the process refer to the British Pharmacopœia.—*Dose,* ½ to 2 gr.

b. (Ph. L.) Koochla or poison nuts (seed or fruit of *Strychnos nux vomica*), 8 oz.; rectified spirit, 3 pints; expose them to steam until softened, then bruise, slice, and dry them, and macerate them in 2-3rds of the spirit for 7 days; express the tincture, and repeat the maceration with the remaining 1-3rd of the spirit; again express the liquid; lastly, filter the mixed tinctures, distil off the greater part of the spirit, and complete the evaporation by a gentle heat. The formula of the P. Cod. is similar, but using spirit sp. gr. ·863 (=41 o. p.).

c. (Ph. E.) The sliced and dried nuts are to be ground in a coffee-mill, and either exhausted by percolation with rectified spirit or by boiling the powder in repeated portions of the menstruum. The formulæ of the Ph. Baden and U. S. are similar.

d. (Ph. D. 1826.) From a tincture of the rasped nut made with proof spirit, observing that the extract, whilst thickening, should be properly stirred.

Obs. This extract consists chiefly of impure igasurate of strychnia, and is exhibited in similar cases to that alkaloid. Used as a stimulant of the nervous system in paralysis.—*Dose,* ½ gr., gradually and cautiously increased to 2 gr. It is very poisonous. On the large scale, the nuts are ground in a drug-mill.

Extract of Oak Bark. *Syn.* Extractum quercûs, E. corticis quercûs, L. *Prep.* (Ph. D. 1826.) From the decoction. Astringent.—*Dose,* 10 gr. to ½ dr. Now seldom used.

Extract of O′pium. *Prep.* 1. (Aqueous extract of opium, Simple E. of O.; Extractum opii (B. P.), E. o. aquosum (Ph. D.), E. o. purificatum, L.) *a.* (B. P.) Opium in thin slices, 1 lb.; distilled water, 6 pints. Macerate the opium in 2 pints of the water for 24 hours and express the liquor. Reduce the residue of the opium to a uniform pulp, macerate again in 2 pints of the water for 24 hours, and express. Repeat the operation a third time. Mix the liquors, strain through flannel, and evaporate by a water-bath until the product weighs ½ lb.—*Dose,* ½ to 1 gr., or more.

b. (Ph. L.) Opium (powdered), 1½ lbs.; distilled water (cold), 2½ pints; mix gradually, and macerate for 24 hours, frequently stirring with a spatula; (press,) strain, and repeat the maceration for 24 hours with a fresh quantity (2½ pints) of water; lastly, evaporate the (mixed) strained liquors to a proper consistence. The formulæ of the Ph. E., D., and Baden, and P. Cod., are essentially the same.

c. (Ph. D. 1826.) As the last, but using boiling water, and exposing the mixed liquors to the air for 2 days, before filtering, and evaporating them. Inferior to the last.

d. (Purified.) The extract, prepared with cold water, is evaporated to dryness, powdered, and redissolved in cold water; after 48 hours' exposure and defæcation, it is decanted from the dregs, filtered, and gently evaporated as before. Superior to any other extract of opium made.

Obs. Good opium yields from 60% to 70% of its weight of extract, but much depends upon the variety used.—*Dose,* ¼ to 2 gr., as an anodyne, sedative, and hypnotic. It is less stimulating than ordinary opium. That prepared by the third formula is, indeed, scarcely inferior in its action to the salts of morphine.

This extract is kept in both the hard and soft state (extractum opii durum, e. o. molle). A solution of the former, in distilled water, with the addition of a little spirit to keep it, forms Battley's 'liquor opii sedativus.' The Dublin formula is that adopted by the wholesale druggists.

Besides the aqueous extract, there are the following preparations:

2. (Extractum opii liquidum, B. P.; Liquid extract of opium.) Extract of opium, 1; distilled water, 16; rectified spirit, 4. Digest the extract of opium in the water for an hour, stirring frequently; filter, and add the spirit. The product should measure 20.—*Dose,* 10 to 30 minims.

3. (Acetic: Extractum opii aceticum, L.; *Soubeiran.*) Opium, 1 oz.; distilled vinegar, 1 quart; digest 2 days (with heat), decant, filter, and evaporate.

4. (Alcoholic: Extractum opii alcoholicum, L., Ph. Antwerp.) From the tincture.

5. (Aqueo-alcoholic: E. opii aquo-alcoholicum, L.; *Taddei.*) The opium, exhausted by spirit, is digested in warm water, and the infusion and tincture, separately filtered, are mixed and evaporated.

6. (De-narcotised: Extractum opii absque narcotina, L.) *a.* (P. Cod.) The aqueous extract is reduced with hot water to the consistence of a syrup, and when cold this is mixed with 8 times its volume of ether, and the whole is frequently shaken for a day or two; the ethereal solution is then decanted, and the process repeated with fresh ether, as long as it dissolves anything. The original form of Robiquet is similar. Said to consist entirely of impure muriate of morphine, gum, and extractive.

b. (*M. Lamousin-Lamothe.*) Aqueous extract, 4 parts; resin, 1 part; beat well together; add boiling water, 16 parts; boil to ½; add cold water, 8 parts, filter, and evaporate.

7. (By fermentation: Extractum opii per fermentationem, L.) *a.* Opium and sugar, of each, 4 oz.; water, 1 quart; rub together, and keep the mixture, loosely covered, in a warm situation (about 70° F.), for 10 days or more; then add of cold water, 1 quart, and the next day filter and evaporate.

b. (*Duyeux.*) From an unstrained mixture of opium, 1 part, with water, 8 parts, and a little yeast; left for a week at a temperature of 68°—77° F., and then diluted, filtered, and evaporated. Quince juice has been recommended as the menstruum.

8. (Roasted: Extractum opii torrefacti, L.; *Guibourt.*) Powdered opium is heated on a flat dish over a moderate fire, with constant stirring, as long as fumes are given off; it is then exhausted by treating it twice with 6 times its weight of water, and the mixed liquor, after filtration, is evaporated.

9. (Vinous: Extractum opii vino paratum, L.; P. Cod.) From wine of opium. The above extracts of opium (excepting the alcoholic) are regarded as less exciting than the other preparations of the drug. The dose of each is similar to that of the aqueous extract.

Extract of Or′ange Peel. *Syn.* Extractum corticis aurantii, L. *Prep.* 1. From the thin yellow peel, as extract of madder.

2. See Aurantii.

Extract of Ox-gall. *Syn.* Inspissated ox-gall; Extractum fellis bovini, L. *Prep.* (P. Cod.) From ox-gall, strained, and evaporated in a water-bath.—*Dose,* 5 to 15 gr.; in pills.

2. (*Hunter Lane.*) As the last, but reducing the gall to dryness, and then powdering it. It must be preserved in well-corked bottles.—*Dose,* 3 to 12 gr.

Extract of Parei′ra. *Syn.* Extractum pareiræ (B. P.), L. *Prep.* 1. (B. P.) Pareira root in coarse powder, 1; boiling distilled water, 10, or a sufficiency; digest the pareira with 1½ of water for 24 hours, then pack in a percolator and water till by slow percolation 10 has passed through; evaporate in a water-bath to a pilular consistence. —*Dose,* 13 to 20 gr.

2. (Ph. L.) From the root of velvet leaf or pareira brava (*Cissampelos pareira*), as extract of hops (Ph. L.).

3. (P. E.) As extract of liquorice. (Ph. E.) The P. Cod. formula is similar. Alterative, tonic and diuretic.—*Dose,* 10 gr. to ½ dr.; chiefly in affections of the bladder.

Extractum Pareira Liquidum. *Syn.* Liquid extract of pareira (B. P.). Dissolve 4 parts of

extract of pareira in a sufficient quantity of a mixture of 1 fl. part of rectified spirit, and 3 parts of water, to form 16 fl. parts of liquid extract; filter.—*Dose*, ½ to 2 dr.

Extract of Par'sley. *Syn.* EXTRACTUM PETROSELINI, L. *Prep.* 1. (P. Cod.) From the root, as EXTRACT OF BISTORT (P. Cod.).

2. (*M. Peraibe.*) From the fresh leaves, as EXTRACT OF ACONITE. Febrifuge and tonic.—*Dose*, 5 to 10 gr.

Extract of Pasque Flower. *Syn.* EXTRACTUM ANEMONIS, L. *Prep.* (P. Cod.) From the recent or dried flower, as either of the EXTRACTS OF ACONITE (P. Cod.).—*Dose*, 1 to 4 gr.

Obs. Several species of *Anemone* have been used in *medicine*, especially *Anemone pratensis* and *A. pulsatilla.* According to Baron Stoerck, the former is resolvent, and is an effectual remedy in various chronic diseases, particularly in amaurosis, cataract, opacity of the cornea, nocturnal pains, suppressions, &c. ½ to 1 gr., combined with sugar of milk, has been highly recommended in hooping-cough.

Extract of Pa'tience Dock. *Syn.* EXTRACTUM PATIENTIA, L. *Prep.* From the root of *Rumex patientia* or garden patience, as EXTRACT OF HOPS. Aperient and stomachic. Used in double doses in lieu of extract of rhubarb.

Extract of Paullin'ia. See EXTRACT OF GUARANA.

Extract of Peach Blossom. *Prep.* From essence of lemons, 1 oz.; pure balsam of Peru, 2 dr.; essence (oil) of bitter almonds, 1 dr.; rectified spirit, 3 pints; spirit of orange flowers, 1 pint; spirit of jasmine, ¼ pint; mix. A pleasant and powerful perfume.

Extract of Pel'litory *Syn.* EXTRACTUM PYRETHRI, E. P. ÆTHERO-ALCOHOLICUM, L. *Prep.* (*W. Procter.*) Alcohol (rectified spirit), 1 pint; ether, ½ pint; mix and pour it gradually on root of pellitory (*Anacyclus pyrethrum*), 1 lb., placed in a percolator; afterwards pour on alcohol, 1 pint; and subsequently sufficient dilute alcohol (proof spirit) to displace 2½ pints of tincture (ESSENCE OF PELLITORY, TOOTHACHE ESSENCE); the latter is either suffered to evaporate spontaneously, or by a very gentle heat, until a soft extract is obtained. Used to destroy the sensibility of the nerves of the teeth, previous to plugging, and for toothache.

Extract of Pep'per. *Syn.* EXTRACTUM PIPERIS, E. P. NIGRI, L. *Prep.* 1. From decoction of black pepper (bruised). Stimulant; stronger tasted than the berries, but less aromatic.—*Dose*, 10 gr. to 1 dr.; in agues.

2. (Fluid: EXTRACTUM PIPERIS FLUIDUM, L.) (Ph. U. S.) From black pepper, as FLUID EXTRACT OF CUBEBS (Ph. U. S.), separating the PIPERINE by expression through a cloth, and keeping the fluid portion for use.

Extractum Physostigmatis. See EXTRACT OF CALABAR BEAN.

Extract of Pimpinel'la. *Syn.* EXTRACTUM PIMPINELLÆ, L. *Prep.* From the root of burnet saxifrage (*Pimpinella saxifraga*), as EXTRACT OF HOPS. Astringent.—*Dose*, 10 to 20 gr.

Extract of Pink'root. *Syn.* EXTRACT OF WORM-GRASS, E. OF WORM-SEED ROOT; EXTRACTUM SPIGELIÆ, L. *Prep.* 1. From Carolina pinkroot (*Spigelia marylandica*), as EXTRACT OF BOX (P. Cod.).—*Dose*, 5 to 20 gr.

2. (Fluid: ESSENCE OF PINKROOT, LIQUOR OF P.; EXTRACTUM SPIGELIÆ FLUIDUM, L.) Pinkroot, 1 lb.; proof spirit, 3 pints; make a tincture, evaporate to 10 fl. oz., add sugar, ¾ lb., and rectified spirit, q. s. to make the whole measure exactly a pint.—*Dose.* For a child, beginning with ½ teaspoonful.

3. (Compound: COMPOUND LIQUOR OF PINKROOT; EXTRACTUM SPIGELIÆ FLUIDUM COMP., L.) *a.* (*Estlack.*) Carolina pinkroot or spigelia (bruised), 4 oz.; senna, 3 oz.; savine, 1 dr.; pour on boiling water, 1 quart; when cold, add rectified spirit, ½ pint; digest 24 hours, express (or percolate), filter, evaporate to 12 fl. oz., in which dissolve manna, 1 oz.; sugar, 8 oz. Every fl. oz. is equal to 2 dr. of pinkroot and 1½ dr. of senna. —*Dose.* For a child, ½ to 1 teaspoonful; for an adult, a tablespoonful.

b. (*W. Procter.*) Pinkroot, 16 oz.; senna, 8 oz. (both in coarse powder); dilute alcohol (sp. gr. ·935), 2 pints; macerate for 2 days, then proceed by displacement, adding fresh spirit, until 4 pints have passed through; filter, evaporate to 20 fl. oz., and add carbonate of potassa, 1 oz.; next add oils of caraway and aniseed, of each, ½ dr.; (previously triturated with) powdered sugar, 24 oz.; lastly, apply a gentle heat to dissolve the sugar.

c. (EXTRACTUM SPIGELIÆ ET SENNÆ FLUIDUM, Ph. U. S.) As the last (nearly).—*Dose.* As above. All the above preparations of pinkroot are regarded as powerful and certain anthelmintics, particularly the last two.

Extract of Pipsis'sewa. See EXTRACT OF WINTER-GREEN.

Extract of Poi'son Oak. *Syn.* EXTRACTUM RHOIS TOXICODENDRI, L. *Prep.* (P. Cod.) From the expressed juice of the leaves of *Rhus toxicodendron.* Narcotic, stimulant, and alterative. —*Dose*, ½ to 1 gr., gradually increased; in chronic rheumatism, obstinate skin diseases, &c.

Extract of Pomegran'ate. *Syn.* EXTRACTUM GRANATI, L. *Prep.* 1. (*Soubeiran* and P. Cod.) From the root-bark of pomegranate, as EXTRACT OF BOX. In tapeworm.—*Dose*, 10 to 20 gr.; followed by a purgative.

2. (E. G. CORTICIS FRUCTÛS, L.) From the decoction of the fruit-rind. As the last.

Extract of Pop'pies. *Syn.* EXTRACTUM PAPAVERIS (B. P.), E. P. ALBI, L. *Prep.* 1. (B. P.) Capsules coarsely powdered, 16; rectified spirit, 2; distilled water, a sufficiency; mix the poppy capsules with 40 of the water, stirring them frequently during 24 hours; then pack in a percolator, and pass water slowly through them until about 160 have passed through; evaporate the liquor by a water-bath to 20; when cold, add the spirit. After 24 hours filter the liquor, and evaporate to a pilular consistence.—*Dose*, 2 to 5 gr.

2. (Ph. L.) Bruised poppy-heads (without the seed), 15 oz.; boiled distilled water, 1 gall.; macerate 24 hours, boil to ½, strain, and complete the evaporation.

3. (Ph. E.) As the last, with 'capsules not quite ripe.'

Obs. The medical action of extract of poppies, for the most part, resembles that of opium; but

it is considerably weaker, and is generally regarded as less prone to produce headache and delirium. —*Dose,* 2 to 12 gr. It is usually prepared by the large manufacturers by exhausting the capsules by coction with water; hence the inferior quality of the extract of the shops, which contains a considerable quantity of inert matter.

The principal consumption of this extract is among the brewers, brewers' druggists, and wine merchants. For this purpose it is evaporated until it becomes hard on cooling, when it is formed into ½-lb. rolls, and covered with paper, like lead plaster. One of these rolls added to a hogshead of ale, stout, or sherry, materially increases the 'headiness' or apparent strength of these beverages.

Extract of Pota'to. *Syn.* EXTRACTUM SOLANI TUBEROSI, L. *Prep.* (*Dr J. Latham.*) From the stem and leaves of the potato-plant, as EXTRACT OF ACONITE (Ph. L.). Narcotic.—*Dose,* 2 to 10 gr.

Extract of Pur'ging Flax. *Syn.* EXTRACTUM LINI CATHARTICI, L. *Prep.* (*Dr B. Lane.*) From the dried herb, as EXTRACT OF HOPS (Ph. L.). Aperient and diuretic.—*Dose,* 5 to 10 gr.; 14 lbs. yielded 2¼ lbs. of extract.

Extract of Quas'sia. *Syn.* EXTRACTUM QUASSIÆ (B. P.), E. Q. LIGNI, L. *Prep.* 1. (B. P.) Quassia scraped, 1 lb.; distilled water, a sufficiency; macerate the quassia in 8 oz. of water for 12 hours; pack in a percolator; add water till the quassia is exhausted; evaporate, filter before it becomes thick, and again evaporate in a water-bath to a proper consistence for pills.—*Dose,* 2 to 5 gr.

2. From the decoction of quassia chips.—*Prod.,* 5% to 6%.

3. (Ph. E.) From the rasped wood, as EXTRACT OF BISTORT (P. Cod.). Bitter and stomachic.—*Dose,* 5 to 10 gr., or more.

Obs. This extract is almost universally prepared by coction, and is principally consumed by the brewers, who employ it as a substitute for hops, in large quantities. The bark is frequently substituted for the wood, but is considerably less bitter. The Ph. Baden has an extract prepared with spirit of ·944.

Extract of Quince Seeds. *Syn.* EXTRACTUM CYDONIÆ, E. C. SEMINUM. *Prep.* From the decoction. Sucked as a lozenge, in hoarseness, &c.

Extract of Ragwort. *Syn.* EXTRACTUM JACOBÆÆ. The inspissated juice of ragwort.

Extract of Rha'tany. *Syn.* EXTRACTUM RHATANIÆ, E. KRAMERIÆ (B. P.), L. *Prep.* 1. (B. P.) Rhatany in coarse powder, 1; cold distilled water, 15; macerate 24 hours in 2 of the water, then percolate the whole; evaporate by water-bath to dryness.—*Dose,* 5 to 20 gr.

2. (Ph. E., Baden, and U. S.) From dried rhatany root (*Krameria triandria*), as EXTRACT OF BISTORT (P. Cod.).

3. (Ph. Bor.) By two successive macerations in boiling water of 24 hours each, and evaporating at a temperature not exceeding 165° F.

Obs. Extract of rhatany is astringent and tonic.—*Dose,* 10 to 20 gr. A large quantity of this extract, of very inferior quality, is imported from Brazil, and other parts of South America. It is kept in two states, hard and soft: the former resembles KINO, and is often sold for it; the latter is chiefly consumed by the manufacturers and 'improvers' of port wine.

Extract of Rhu'barb. *Syn.* EXTRACTUM RHEI (B. P.), L. *Prep.* 1. (B. P.) Rhubarb (sliced or bruised), 8 oz.; rectified spirit, 5 oz.; distilled water, 50 oz.; macerate 4 days, strain and set it aside, that the fæces may subside; next decant the clear portion, strain, mix, and evaporate to a proper consistence over a water-bath at 160° F.

2. (Ph. L.) As EXTRACT OF CINCHONA, Ph. L. (nearly). "The extract is obtained of finer quality by evaporation in a vacuum with a gentle heat." The Baden formula is similar.

Obs. This extract is usually prepared by decoction from inferior and damaged rhubarb, picked out from the chests on purpose; hence the inferior quality of the extract of the shops. When made of good Turkey, or even East India rhubarb, it is a very valuable preparation.—*Dose.* As a stomachic, 5 to 10 gr.; as a purgative, 10 gr. to ½ dr. It is seldom exhibited alone. *Prod.,* 5%.

3. (Fluid: LIQUOR OF RHUBARB, ESSENCE OF R.; LIQUOR RHEI, EXTRACTUM RHEI FLUIDUM, L.) *a.* (*W. Procter.*) Rhubarb in coarse powder, 8 oz.; mix it with an equal bulk of coarse sand, and moisten it with dilute alcohol (sp. gr. ·935 = 13 u. p.) to form a pasty mass; in a short time introduce it into a percolator, shake it until uniformly settled, and cover it with cloth or paper; then pour on the rest of the spirit (the remainder of 2 pints) until the product has little odour or taste of the root; next gently evaporate the tincture to 5½ fl. oz., and add sugar, 5 oz., when the whole should measure 8 fl. oz.—*Dose,* 15 to 30 drops.

b. (Ph. U. S.) As the last, adding of oils of fennel and anise, of each, 4 drops, (dissolved in) tincture of ginger, 4 fl. dr.

4. (Compound: EXTRACTUM RHEI COMPOSITUM, E. PANCHYMAGOGUM, L., Ph. Bor.) Extract of rhubarb, 3 dr.; extract of aloes, 1 dr., (softened with) water, 4 dr.; mix, and add soap of jalap, 1 dr., (dissolved in) proof spirit, 4 dr.; lastly, evaporate to an extract; dry this in a warm place, and powder. Stomachic and purgative.—*Dose,* 4 to 20 gr.

Extract of Rue. *Syn.* EXTRACTUM RUTÆ, E. FOLIORUM RUTÆ, L. *Prep.* 1. From rue leaves (*Rutæ graveolens*), as EXTRACT OF HOPS (Ph. L.).

2. (Alcoholic: Ph. Cod.) As ALCOHOLIC EXTRACT OF ACONITE, P. Cod. (nearly). The formula of the Ph. Wurt. is similar.

Obs. This extract is stomachic, carminative, and emmenagogue.—*Dose,* 10 to 20 gr., twice a day. It is usual to add a little of the essential oil to the extract, just before taking it out of the evaporating-pan, and when nearly cold. The first is the form adopted in trade in this country.

Extract of Saf'fron. *Syn.* POLYCHROITE; EXTRACTUM CROCI, L. *Prep.* 1. From hay-saffron, as EXTRACT OF COLOCYNTH (Ph. L.).

2. (P. Cod.) From the tincture. Superior to the last.

Obs. The first is used chiefly as a colouring and flavouring substance by cooks, confectioners,

wine and cordial brewers, &c.—*Dose*, 5 to 15 gr., as an excitant, antispasmodic, and emmenagogue.

Extract of Sarsaparil'la. *Syn.* EXTRACTUM SARZÆ, E. SARSAPARILLÆ, L.; EXTRAIT DE SALSEPAREILLE, Fr. *Prep.* 1. (Ph. L. 1836.) From sarsaparilla, as EXTRACT OF HOPS (Ph. L.). The Ph. D. 1826 is similar.—*Dose*, 10 gr. to 1 dr.—*Prod.* (from Jamaica sarsaparilla), 32% to 36%.

2. (Alcoholic: EXTRACTUM SARZE ALCOHOLICUM, L.) *a.* From a tincture of the root-bark, prepared with proof spirit, either by digestion or percolation.

b. (P. Cod. and Ph. U. S.) From sarsaparilla root (powdered), as ALCOHOLIC EXTRACT OF ACONITE (P. Cod.). Superior to the aqueous extract.—*Dose*, 10 to 20 gr.

3. (EXTRACTUM SARZÆ LIQUIDUM; LIQUID EXTRACT OF SARSAPARILLA, B. P.) *a.* Sarsaparilla in No. 40 powder, 40 oz.; proof spirit, 2 pints; sugar, 5 oz.; distilled water, 12 pints. Mix the sarsaparilla with the spirit, macerate for 10 days; press out 20 oz. of liquor, and set it aside. Mix the pressed residue with the water, macerate at 160° F. for 16 hours, strain, press, and dissolve the sugar in the liquid, evaporate to 18 oz. Mix the two liquids, make it to measure 40 oz. by adding water.—*Dose*, 2 to 4 dr.

b. (Ph. L.) Sarsaparilla, 3½ lbs.; distilled water, 3 galls.; boil to 12 pints, pour off the liquor, and strain whilst hot; again boil the sarsaparilla in water, 2 galls., to one half, and strain; evaporate the mixed liquors to 18 fl. oz.; and when cold add of rectified spirit, 2 fl. oz. Each fl. oz. represents 2⅛ oz. of the root (nearly).

c. (Ph. E.) Sarsaparilla, 1 lb.; boiling water, 4 pints; digest 2 hours, then bruise the root, boil it for 2 hours, filter, and express the liquid; repeat the coction with water, 2 pints, as before; evaporate the mixed liquors to the consistence of a thin syrup, and, when cold enough, add of rectified spirit, q. s. to make up 16 fl. oz. Each fl. oz. represents 6 dr. of the root, and 6 fl. oz. of the decoction.

d. (Ph. D.) Sarsaparilla, 1 lb. (avoir.); proceed as before, and add of rectified spirit, q. s. to make the product up to 20 fl. oz. Strength, as the last (nearly). In the Ph. D. 1826 the decoction of sarsaparilla, 1 lb. (troy), was ordered to be evaporated to 30 oz., which, with the spirit (2 oz.), made the preparation only half the strength of the present one.

4. (Compound: EXTRACTUM SARZÆ COMPOSITUM, E. SARSAPARILLÆ COMP., L.) There is no form for this preparation in the Pharmacopœias, but it is nevertheless in immense demand, from its great convenience in dispensing. The following formulæ are employed by one of the wholesale houses that does largest in this preparation:

a. Guaiacum shavings (from which the small has been sifted), 30 lbs.; Italian juice, 24 lbs.; mezereon root, 6 lbs.; are boiled with water, q. s., for 1 hour; the decoction is then drawn off, and the boiling repeated with fresh water a second and a third time; the mixed decoctions are allowed to deposit for 6 or 8 hours, or longer, and the clear portion decanted and strained through flannel; the liquid is now reduced to the consistence of treacle, when extract of sarsaparilla, 9 lbs., is added, and the evaporation conducted at a considerably lower temperature until near its completion, when the source of heat is removed, and the remaining evaporation conducted at the expense of that retained by the metal of the 'pan.' When nearly cold, and just before removing the extracts to the 'pots' or 'jars,' essential oil of sassafras, 2 dr., dissolved in rectified spirit, 1 quart, is added, and quickly but completely stirred in. The product is a very showy article, if well managed, and weighs about 45 lbs., the precise quantity depending on the quality of the juice employed. It is labelled 'EXT. SARZÆ COMP.'

b. As the last, but only using 15 lbs. of juice, and that Solazzi.—*Prod.* About 35 lbs. It is labelled and sent out as 'EXT. SARZÆ CO. OPT.'

c. By any of the forms given under COMPOUND DECOCTION OF SARSAPARILLA, either common or concentrated, by continuing the evaporation.—*Dose.* Same as that of the simple extract.

5. (Fluid Compound: COMPOUND LIQUOR OF SARSAPARILLA.) *a.* From any of the preceding formulæ by arresting the evaporation when the fluid has acquired the consistence of a thin syrup, and adding to each pint, when cold, rectified spirit, 4 fl. oz.

b. (Alcoholic: *W. Hodgson.*) Sarsaparilla (bruised), 16 oz.; liquorice root (bruised), guaiacum wood (rasped), and sassafras bark (sliced), of each, 2 oz.; mezereon (sliced), 6 dr.; spirit, sp. gr. ·935 (=13 u. p.), 7 pints; digest 14 days, express, filter, evaporate to 12 fl. oz.; add of sugar, 8 oz., and as soon as this is dissolved withdraw the heat. Stronger than the last.—*Dose*, 1 fl. dr.

c. (Ph. U. S.: EXTRACTUM SARSAPARILLÆ COMPOSITUM FLUIDUM.) *Prep.* Sarsaparilla in moderately fine powder, 16 oz. (troy); liquorice root in moderately fine powder, 2 oz. (troy); sassafras in moderately fine powder, 2 oz. (troy); mezereon in moderately fine powder, 360 gr.; glycerin, 4 oz. (old measure); rectified spirit, 8 oz. (old measure); water, 4 oz. (old measure). Macerate in a closed percolator for 4 days, and then let the percolation commence, and finish it by adding diluted alcohol (equal volumes of alcohol at ·835, and water), until 2 pints (old measure) have been obtained. Reserve the first 12 oz., having added 4 oz. (old measure) of glycerin to the remainder of the percolate, which evaporate to 6 oz. (old measure), and mix with the reserved portion.

6. (From the root-bark: EXTRACTUM CORTICIS SARZÆ, L.) From the decoction or tincture of the root-bark. The cortical portion of sarsaparilla yields fully 50% of aqueous extract. "Five times as much as the meditullium" (*Pope*).

Obs. Each of the above extracts of sarsaparilla (simple, fluid, and compound), when of good quality, dissolves in water, forming a deep reddish-brown solution, perfectly transparent, and depositing little sediment, even by standing some days. See SARSAPARILLA.

Extract of Savine. *Syn.* EXTRACTUM SABINÆ. 1. (Ph. L. 1788.) By evaporating a decoction of dry savine.

2. (Ph. U. S.: EXTRACTUM SABINÆ FLUIDUM.) As fluid extract of cubebs (Ph. U. S.).

Extract of Scam'mony. *Syn.* Resin of scammony; Resina scammonii, Extractum s. alcoholicum, E. sive resina scammonii (Ph. E.), L. *Prep.* 1. From powdered scammony, exhausted with proof spirit, and the resulting tincture distilled until little but water passes over; the remaining water is then poured from the resin, which is next well washed in boiling water and dried at a temperature below 240° F. Brown; impure.

2. As the last, but using either alcohol of 90% or ether and animal charcoal. White; pure.

Obs. Scammony resin is translucent, fusible, and combustible; and freely soluble in alcohol, ether, and oil of turpentine. It is frequently adulterated with jalap resin, a fraud readily detected by its insolubility in the last two menstrua. —*Dose*, 5 to 10 gr. "When pure or virgin scammony can be procured it is an unnecessary preparation" (*Pereira*).

Extract of Scurvy-grass. *Syn.* Extractum cochleariæ, L. *Prep.* (P. Cod.) From the clarified juice of fresh scurvy-grass by exposure to warm air. Antiscorbutic, stimulant, antirheumatic, and diaphoretic.—*Dose*, 1 to 2 dr. The valuable principles of the juice are dissipated by much heat.

Extract of Sen'ega. *Syn.* Extractum senegæ, L. *Prep.* 1. (P. Cod.) From senega or snakeroot (*Polygala senega*), as extract of box (P. Cod.).

2. (Compound: Extractum senegæ compositum, E. s. et scillæ, L. *Ecky.*) From equal parts of squills and senega, as the last, but by displacement. Both the above are stimulant, expectorant, sudorific, and diuretic.—*Dose*, 1 to 12 gr.

3. (Ph. U. S.: Extractum senegæ fluidum.) As extract of cotton-root (Ph. U. S.).

Extract of Sen'na. *Syn.* Extractum sennæ, L. *Prep.* 1. (Extractum sennæ aquosum, L.) *a.* As extract of colocynth (Ph. L.).

b. (P. Cod.) As extract of bistort (P. Cod.).

c. (Ph. Bor.) From senna leaves, by maceration in tepid water (104° F.) for 24 hours, and expression and filtration; the operation is repeated with fresh water, and the strained liquors evaporated to a thick extract (at 149°—157° F.), which is dissolved in water, 4 parts, the solution filtered, and again evaporated.—*Dose*, 10 to 20 gr. It is principally used as a basis for purgative pill. When prepared by decoction it is nearly inert. A better extract is prepared from the common tincture made with proof spirit.

2. (Alcoholic: Extractum sennæ alcoholicum, L. *Guibourt.*) Senna (in powder), 1 part; rectified spirit, 5 parts; heat gradually to boiling, let it cool; in 24 hours express, strain, and repeat the process with fresh spirit; lastly, distil and evaporate. Proof spirit answers for this purpose.

3. (Fluid: Extractum sennæ fluidum, L., Ph. U. S.) Senna (in coarse powder), $2\frac{1}{2}$ lbs.; spirit (at or near proof), 64 fl. oz.; macerate 24 hours, then act by displacement, subsequently adding weak spirit (1 of rectified spirit to 3 of water) until 10 pints of tincture are obtained; evaporate to 1 pint, filter, add sugar, 20 oz., and oil of fennel, 1 dr., (dissolved in) compound spirit of ether, 2 fl. dr. Every fl. oz. represents 1 oz. of senna.

Extract of Smoke. *Syn.* Extractum fuliginis, L. *Prep.* 1. (Aqueous.) Wood-soot, 2 oz.; water, 1 pint; boil to 16 fl. oz., filter and evaporate.

2. (Acetic.) Wood-soot, 2 oz.; distilled vinegar and water, of each, $\frac{1}{2}$ pint; as the last. Formerly reputed antispasmodic, alterative, &c. —*Dose*, 3 to 6 gr., 2 or 3 times a day; in dyspepsia, hysteria, cancer, scrofula, and various syphilitic affections.

Extract of Snake-root. See Extract of Senega.

Extract of Black Snake-root (Fluid). *Syn.* Extractum cimicifugæ fluidum (Ph. U. S.). *Prep.* As fluid extract of cubebs (Ph. U. S.).

Extract of Soap'wort. *Syn.* Extractum saponariæ, L. *Prep.* (P. Cod. and Ph. Bad.) From the dried roots of soapwort (*Saponaria officinalis*), as extract of bistort (P. Cod.). Aperient and alterative.—*Dose*, 15 gr. to $\frac{1}{2}$ dr.

Extract of Spruce. See Essence of Spruce.

Extract of Squills. *Syn.* Extractum scillæ, L. *Prep.* 1. (Aqueous: E. s. aquosum.) *a.* (Ph. Baden.) From squills, as extract of colocynth, Ph. L. (nearly).

b. (Ph. Bor.) From squills, as extract of senna, Ph. Bor. (nearly), but using boiling water, avoiding ebullition during the evaporation, and powdering the residuum.—*Dose*, 1 to 5 gr.

2. (Alcoholic: Extractum scillæ alcoholicum, L., P. Cod.) From the tincture prepared with proof spirit, by distillation and evaporation. —*Dose*, $\frac{1}{2}$ to 3 gr., as an expectorant and diuretic, twice or thrice a day. In larger doses it is nauseant and emetic.

3. (Acetic: Extractum scillæ aceticum.) Digest powder of squills, 1 lb., in acetic acid, 3 oz.; and distilled water, 1 pint, with a gentle heat, for 48 hours.

Express strongly and without straining; evaporate to a proper consistence. (1 gr. of this is said to equal 3 gr. of the powder.)

Extract (Fluid) of Stillingia. *Syn.* Extractum stillingiæ fluidum (Ph. U. S.). *Prep.* Stillingia, in fine powder, 16 oz. (troy); macerate with 12 oz. (old measure) of rectified spirit; 3 oz. (old measure) of glycerin; and 1 oz. (old measure) of water, for 4 days in a closed percolator, and proceed as for fluid extract of cotton-root (Ph. U. S.).

Extract of Stor'ax. See Styrax.

Extract of Stramo''nium. *Syn.* Extract of thorn-apple; Extractum stramonii (Ph. L. and D.), L. *Prep.* 1. (B. P.) Pack stramonium seeds, coarsely powdered, in a percolator, and pass about their own weight of washed ether slowly through them, remove the ether, and set aside. Now pour over them proof spirit until the seeds are exhausted; distil off the spirit, and evaporate the residue by a water-bath to a proper pill consistence.—*Dose*, $\frac{1}{4}$ gr., gradually increasing.

2. (Ph. L.) Seeds of thorn-apple (*Datura stramonium*), 15 oz.; boiling distilled water, 1 gall.; macerate for 4 hours in a vessel lightly covered, near the fire; afterwards take out the seeds, bruise them in a stone mortar, and return them to the liquor; then boil down to 4 pints, strain whilst hot, and

evaporate. The Ph. D. is similar.—*Prod.*, (about) 12%. Anodyne and narcotic.—*Dose*, ¼ gr. to ½ gr., gradually increased, twice or thrice a day; neuralgia, rheumatism, tic-douloureux, spasmodic asthma, epilepsy, worms, &c.

3. (P. Cod. and Ph. U. S.) From the expressed juice of the fresh leaves, heated to boiling, and filtered. The P. Cod. also orders it to be prepared as EXTRACT OF ACONITE (Ph. L.). Anodyne and narcotic.—*Dose*, ½ to 1 gr.

Obs. On the large scale, this extract is prepared by expressing the juice of the fresh herb, and boiling the remainder in water; the juice and decoction are then mixed, filtered and evaporated. 1½ cwt. of stramonium yielded 37 lbs. of juice, and this, with the decoction, gave 31 lbs. of extract (*Gray*).

4. (Alcoholic: EXTRACTUM STRAMONII, Ph. E., E. S. ALCOHOLICUM, L.) *a.* (Ph. E. and Ph. U. S.) From the seeds (ground in a coffee-mill), by percolation with proof spirit.—*Prod.*, (about) 14%; 1 lb. yielded 2¼ oz. (*Recluz*).

b. (P. Cod.) From the leaves, as EXTRACT OF ACONITE (P. Cod.).—*Dose*, ¼ gr. gradually increased (see *above*).

Extract of Suc'cory. *Syn.* EXTRACTUM CICHORII, L. *Prep.* (*Guibourt.*) From the fresh root, as EXTRACT OF ACONITE (Ph. L.). Aperient, deobstruent, and tonic.—*Dose*, 10 gr. to ½ dr.

Extract of Sweet Flag. *Syn.* EXTRACTUM ACIDI, E. CALAMI AROMATICI, L. *Prep.* From the rhizomes, as EXTRACT OF RHUBARB (Ph. L.). See SWEET FLAG.

Extract of Tan'sy. *Syn.* EXTRACTUM TANACETI, L. *Prep.* 1. From the herb (*Tanacetum vulgaris*), as EXTRACT OF HOP (Ph. L.).

2. (*Giordano.*) As EXTRACT OF HOREHOUND (Ph. Lusitan.).

Obs. This extract is said to be tonic, stomachic, anthelmintic, emmenagogue, and febrifuge. Dr Clark says that in Scotland it was found to be serviceable in various cases of gout. The infusion is, however, preferable.—*Dose*, 5 to 20 gr.

Extract of Taraxacum. *Syn.* EXTRACT OF DANDELION; EXTRACTUM TARAXACI (Ph. L. and E.), E. T. HERBÆ ET RADICIS (Ph. D. 1826), L. *Prep.* 1. (B. P.) Crush fresh dandelion root, press out the juice, and allow it to deposit; heat the clear liquor to 212° F., and maintain the temperature for 10 minutes; then strain and evaporate by a water-bath, at a temperature not exceeding 160° F., to a proper consistence.—*Dose*, 5 to 15 gr.

2. (Ph. L.) From the recent root of dandelion (*Leontodon taraxacum*), as EXTRACT OF HOP (Ph. L.). The formulæ of the Ph. E. and U. S. are nearly similar.

3. (Ph. D.) From the herb and root, as the other simple extracts (EXTRACTA SIMPLICIORA).

4. (P. Cod.) From the expressed juice, as EXTRACT OF STRAMONIUM (P. Cod.).

5. (Ph. Bor.) As EXTRACT OF SENNA, Ph. Bor. (nearly).

6. (Ph. Baden.) By displacement with cold water.

7. (Wholesale.) From the decoction.

8. (Fluid.) See LIQUOR OF TARAXACUM.

Obs. The extract of the shops is usually prepared by exhausting the root by coction with water. The products of the first two of the above formulæ, when recent, have a faint and agreeable odour, and a sweet bitter taste; those of Nos. 4, 5, and 6 smell strongly of the recent root, have a pale and lively brownish-yellow colour, and a bitter acidulous taste, without any trace of sweetness; that of the last one is devoid of odour, and possesses a coffee-brown colour, and a sweetish, burnt taste, not much unlike a solution of burnt sugar. The medicinal value of this extract is greatest when the aroma and bitter taste of the recent root are well developed; and when sweet, its efficacy as a remedy is impaired (*Squire*).

Taraxacum root should be gathered during the winter months, when the quantity of the product is looked at; as then a given weight of the juice yields more extract; but in summer and autumn it possesses more bitterness and aroma. 4 lbs. of juice from roots gathered in November and December yielded 1 lb. of extract, while it took from 6 to 9 lbs. of juice from the root, gathered in spring or summer, to yield a like quantity (*Squire*). The herb yields by the evaporation of its expressed juice about 5% of extract. According to Mr Jacob Bell, the average yield of 1 cwt. of root is about 7⅛ lbs. ('Pharm. Journ.,' x, 446).

Good extract of taraxacum should be wholly soluble in water.—*Dose*, 10 gr. to ½ dr.; as a resolvent, aperient, and tonic, in liver and stomach complaints, &c.

Extract of Tea. *Syn.* EXTRACTUM THEÆ, L. *Prep.* 1. From an infusion of any of the rougher kinds of black tea. Astringent. Has been recommended in diarrhœa; formed into pills.—*Dose*, 10 gr. to ½ dr. A hard, black-looking substance, smelling and tasting faintly of tea, is imported under the same name from China.

2. (*Pidding's.*) The joint products of distillation and infusion combined. Proposed to be made in China, and exported as a condensed preparation of tea (ESSENCE OF TEA; ESSENTIA THEÆ), to be used as a substitute for the leaves, in order to save the expense of freight, &c.

Extract of Thorn-apple. See EXTRACT OF STRAMONIUM.

Extract of Tobac'co. *Syn.* EXTRACTUM TABACI, E. NICOTIANÆ, L. *Prep.* 1. (*Chippendale.*) From decoction of tobacco. Proposed as an external application in neuralgia, &c.

2. (Alcoholic: EXTRACTUM TABACI ALCOHOLICUM, L., Ph. Bor.) Tobacco leaves, 1 lb.; spirit (sp. gr. ·900), 2 lbs.; digest in a warm place for some days, express strongly, and again digest in a mixture of water and spirit (·900), of each, 1 lb., for 24 hours; again press out the liquor, and exaporate the strained and mixed liquors into a vapour-bath, at a temperature not exceeding 167° F.

Extract of Tor'mentil. *Syn.* EXTRACTUM TORMENTILLÆ, L. *Prep.* (Ph. Amst.) From the root of *Potentilla tormentilla*, as EXTRACT OF HOPS (Ph. L.). The Ph. Baden directs its preparation by displacement with cold water. Astringent and febrifuge.—*Dose*, 15 to 30 gr.; in diarrhœa. It was formerly regarded as a specific in syphilis (*Lindley*).

Extract of Triticum (Liquid). *Syn.* EXTRACTUM TRITICI LIQUIDUM, L. *Prep.* Take of triticum (the rhizome of *Triticum repens*, Linné,

gathered in the spring and deprived of the rootlets), in No. 20 powder, 10 oz.; rectified spirit and distilled water, of each, q. s. Moisten the powder with 4 fl. oz. of distilled water, pack in a percolator, and pour boiling distilled water upon it until it is exhausted. Evaporate the percolate to 15 fl. oz., add to it 5 fl. oz. of rectified spirit, mix, and set aside for 48 hours. Then filter the liquid, and add to the filtrate enough of a mixture composed of 3 fl. parts of distilled water and 1 of rectified spirit to make the liquid extract measure 1 pint.—*Dose*, 1 to 6 fl. dr.

Extract of U'va-ur'si. See EXTRACT OF WHORTLEBERRY.

Extract of Valer'ian. *Syn.* EXTRACTUM VALERIANÆ, L. *Prep.* 1. From valerian root, as EXTRACT OF HOP (Ph. L.); but using a covered vessel.

2. (Ph. Bor. and Baden.) As EXTRACT OF CINCHONA, Ph. L. (nearly), employing strong force in the expression of the liquor, and only evaporating to the consistence of syrup.

Obs. It is usual to add to this extract a little of the ESSENTIAL OIL OF VALERIAN, dissolved in a small quantity of rectified spirit, just before removing it from the evaporating-pan, and when nearly cold. Antispasmodic and nervine.—*Dose*, 10 gr. to ½ dr. In hysteric and spasmodic diseases. Valerian yields about 40% of soft extract.

3. (Alcoholic: EXTRACTUM VALERIANÆ ALCOHOLICUM, L., P. Cod.) As EXTRACT OF BOX (P. Cod.).

4. (Fluid: EXTRACTUM VALERIANÆ FLUIDUM, L., Ph. U. S.) Rectified spirit, 12 fl. oz.; mix, add of valerian (in coarse powder), 8 oz.; digest and percolate, adding, subsequently, spirit (at or near proof) until 16 fl. oz. of tincture have passed through; let this evaporate spontaneously, in a shallow vessel, until reduced to 5 fl. oz.; in the meantime add fresh spirit to the mass in the percolator, until 10 fl. oz. more of tincture are obtained, which add to the above residuum of the evaporation, observing to dissolve any oleoresinous deposit in a little rectified spirit, and add it to the rest; lastly, filter, and add of rectified spirit, q. s. to make the whole measure 16 fl. oz.

Extract of Vanil'la. See LIQUOR OF VANILLA.

Extract of Wall-pel'litory. *Syn.* EXTRACTUM PARIETARIÆ, L. *Prep.* From fresh wall-pellitory (*Parietaria officinalis*), as EXTRACT OF ACONITE (Ph. L.). Aperient, diuretic, and pectoral.—*Dose*, 10 gr. to ½ dr.

Extract of Wal'nut. *Syn.* EXTRACTUM JUGLANDIS IMMATURÆ, L. *Prep.* 1. From unripe walnuts (*Juglans regia*), as EXTRACT OF ACONITE (Ph. L.).

2. From the decoction of the green shells. Vermifuge.—*Dose*, 20 to 30 gr. in cinnamon water.

Extract of Walnut Leaves. *Syn.* EXTRACTUM JUGLANDIS FOLIORUM, L. *Prep.* 1. From the decoction of dried walnut leaves.

2. (*Soubeiran.*) By displacement with tepid water. Diaphoretic and alterative.—*Dose*, 2 to 4 gr. twice or thrice a day; in scrofula, scirrhus, &c.

3. (Alcoholic: EXTRACTUM JUGLANDIS FOLIORUM ALCOHOLICUM, L., Ph. Bor.) From walnut leaves (cut), as ALCOHOLIC EXTRACT OF TOBACCO, Ph. Bor. (nearly).

Extract of Wa'ter-dock. *Syn.* EXTRACTUM RUMICIS AQUATICI, L. *Prep.* From the root, as EXTRACT OF HOPS (Ph. L.). Astringent and antiscorbutic.—*Dose*, 15 gr. to 1 dr.; in skin diseases, &c.

Extract of Whor'tleberry. *Syn.* EXTRACT OF BEARBERRY; EXTRACTUM UVÆ-URSI (Ph. L.), L. *Prep.* 1. From the dried leaves of the bearberry (*Arctostaphylos uva-ursi*), as EXTRACT OF HOPS (Ph. L.).—*Dose*, 5 to 15 gr., twice or thrice a day; in chronic diseases of the bladder and kidneys, attended with increased secretion of mucus, without inflammation.

2. (Ph. U. S.: EXTRACTUM UVÆ-URSI FLUIDUM.) As FLUID EXTRACT OF COTTON-ROOT (Ph. U. S.).

Extract of Willow-bark. *Syn.* EXTRACTUM SALICIS. (Ph. Par.) From powdered willow-bark, as EXTRACT OF RHATANY.

Extract of Win'ter Cher'ry. *Syn.* EXTRACTUM ALKEKENGI, L. *Prep.* From the berries of *Physalis alkekengi*, as EXTRACT OF ELDER. Aperient, detergent, and diuretic.—*Dose*, 2 to 4 dr.

Extract of Win'ter-green. *Syn.* EXTRACT OF PIPSISSEWA; EXTRACTUM CHIMAPHILÆ, L. *Prep.* From the herb winter-green or pipsissewa (*Chimaphila umbellata*), as EXTRACT OF HOPS (Ph. L.).—*Dose*, 10 gr. to ½ dr.; in dropsy, scrofula, and chronic affections of the urinary organs.

Extract of Wood-sor'rel. *Syn.* EXTRACTUM ACETOSELLÆ, L. *Prep.* (*Pideret.*) From the expressed juice of the fresh herb (*Oxalis acetosella*). Acid, bitter, and antiscorbutic.—*Dose*, 15 gr. to ½ dr.

Extract of Worm-grass. See EXTRACT OF PINKROOT.

Extract of Worm'-seed. *Syn.* EXTRACTUM CINÆ ÆTHEREUM, E. SEMINUM C. Æ., L. *Prep.* (Hamb. Cod. 1845.) Worm-seed, 1 oz.; ether, 4 oz.; digest 3 or 4 days, press, filter, distil off 4-5ths, and evaporate the residuum to a proper consistence.—*Prod.*, 25% to 30%. Vermifuge.—*Dose*, 3 to 10 gr., night and morning, for 2 or 3 successive days, followed by a brisk purge.

Extract of Wormwood. *Syn.* EXTRACTUM ABSINTHII, E. ARTEMISIÆ ABSINTHII, L. *Prep.* 1. (Ph. D. 1826.) From the dried flowering tops of wormwood, as the other simple extracts (EXTRACTA SIMPLICIORA, Ph. D.).

2. (Ph. Bor.) As EXTRACT OF RHATANY (Ph. Bor.).

3. (P. Cod. and Ph. Baden.) By displacement by cold water.

Obs. Bitter, stomachic, tonic, and vermifuge.—*Dose*, 10 to 20 gr., 2 or 3 times daily; in dyspepsia, loss of appetite, gout, &c. It is usual to add a few drops of the oil of wormwood to the extract before taking it from the pan.

4. (Alcoholic: EXTRACTUM ABSINTHII ALCOHOLICUM, L. *Guibourt.*) From a tincture prepared from the dried tops of wormwood boiled in proof spirit. More active than the last.

Extract of Yew. *Syn.* EXTRACTUM TAXI, L. *Prep.* 1. (*Loder.*) From the inspissated juice of the fresh leaves of the yew (*Taxus baccata*). Its action on the circulation greatly resembles that of digitalis, but is more manageable.—*Dose*, 1 to 7 gr.; in epilepsy, &c.

2. (Alcoholic: Ph. Baden.) From the dried

leaves, as ALCOHOLIC EXTRACT OF ACONITE (Ph. Baden).

Obs. In addition to the preparations given above, there are many others which are often called 'EXTRACTS.' These may be grouped under the following heads:

Extracts, Concentra'ted. *Syn.* RESINOIDS. Pharmaceutical preparations of more or less value, largely employed by the American physicians who style themselves 'ECLECTICS.' They are supposed to present in the most concentrated form the medicinal virtues of the plants from which they are derived. See RESINOIDS.

Extracts, Fluid. *Syn.* EXTRACTA FLUIDA, E. LIQUIDA, L. This name has been applied in modern *pharmacy* to various preparations differing materially from each other in their degree of fluidity and concentration. Some of these have been already noticed, and others will be found under one or other of their synonyms. Much confusion would be avoided by confining the name 'FLUID EXTRACT' to those preparations only which differ from the ordinary officinal extracts in being in the liquid form; whilst others of a like character, but of less consistence or concentration, might be conveniently classed under the general denomination of 'LIQUORS' (LIQUORES, L.). The various condensed preparations of vegetable substances, now common in trade, professedly several times stronger than the common DECOCTIONS, INFUSIONS, and TINCTURES, might be simply and advantageously distinguished by the addition of 'CONCENTRATED' to their names. Tinctures made with rectified spirit, and of (say) at least 8 times the usual strength, might be appropriately termed 'ESSENCES.' See DECOCTION, ESSENCE, EXTRACT, INFUSION, OLEORESIN, SYRUP, TINCTURE, &c.

Extracts, Perfumatory. See EXTRAIT.

Extracts, Pulver'ulent. *Syn.* DRIED EXTRACTS, DESICCATED E., SACCHARATED E.; EXTRACTA PULVERATA, E. SICCA, E. CUM SACCHARO, L. *Prep.* 1. Ordinary soft extract of the drug, 4 parts; white sugar (in powder), 1 part; mix and dry by exposure in a warm situation; lastly, reduce the mass to powder, and if it weighs less than 4 parts, triturate it with more powdered sugar until its weight is equal to the original weight of the extract used in its preparation. The strength of the extract thus continues unchanged.

2. (Ph. Bor.) As the last, but using powdered sugar of milk, in lieu of cane-sugar.

3. (*Gauger.*) Alcoholic extract, 3 parts; rectified spirit, 1 part, are triturated together in a porcelain mortar until thoroughly incorporated, when white sugar (in powder), 15 oz., is gradually added, and the two carefully and completely blended together; the mixture is dried as before, and more sugar added until the whole weighs exactly 18 oz. 6 gr. represent 1 gr. of the unprepared extract.

Obs. The above are admirable preparations, intended chiefly to render the perishable extracts of the narcotic plants (EXTRACTA NARCOTICA) less liable to suffer by age. See EXTRACT OF ACONITE (Saccharated), &c.

EXTRACTIVE. *Syn.* EXTRACTIVE PRINCIPLE. Fourcroy entertained the belief that all vegetable extracts contained a common basis of definite composition, to which he gave the name of *extractive.* Chevreul and other chemists have shown, however, that Fourcroy's *extractive* is not a chemical compound but a heterogeneous mixture, varying in composition with the plant from which it is obtained. Extractive has a brown colour, or one becoming so in the air; it speedily putrefies, and becomes oxidised, and is rendered insoluble by long exposure to air, and by repeated solutions and evaporations. In its unaltered state it is soluble in water and in alcohol, is nearly insoluble in ether, and is precipitated from its solutions by the acids and metallic oxides. With alumina it forms the basis of several brown dyes.

The term 'extractives' is applied to bodies of unknown character and composition found in most animal fluids.

EXTRAIT. [Fr.] Literally an extract. Among perfumers, extraits are mostly spirituous solutions of the essential oils or odorous principles of plants and other fragrant substances. The French commonly apply the term to any concentrated spirit, either simple or compound. In the shops of the Parisian perfumers upwards of 60 preparations of the kind are distinguished by this name. The extracts of JASMINE, JONQUIL, MAY-LILY, ORANGE BLOSSOMS, VIOLETS, and other like flowers of delicate perfume, are obtained by agitating and digesting the 'huiles' and 'pomades' of the flowers with the purest rectified spirit in the manner described under SCENTED SPIRITS ('esprits'). This process is repeated with fresh oil or pomade until the spirit is rendered sufficiently fragrant. The other extracts (both simple and compound) are made by the common methods of infusion and distillation. See ESSENCE, EXTRACT, SPIRIT, &c.

EYE. In *anatomy* and *physiology*, the organ of vision. In order that vision may be distinct, it is necessary that the pencil of rays diverging from each point of the object and entering the pupil should converge to a focus on the retina. Near-sightedness ('MYOPIA,' L.) is due to the too great convexity of either the 'lens' or 'cornea,' causing the rays to converge to a focus before reaching the retina. The spectacles worn by myopic persons have concave glasses, which, by increasing the divergence of the rays falling upon the eye, have the effect of carrying back each focal point towards the retina. In the long sight of old people ('PRESBYOPIA,' L.) the foci of the refracted pencils are situated behind the retina, the 'lens' or the 'cornea' being not sufficiently convex. This defect is corrected by convex glasses, which increase the convergence of the incidental rays.

Foreign Bodies in the Eye. Particles of dust, small insects, hairs, and such like minute bodies frequently get under the eyelid, and thus become a source of considerable discomfort, and very frequently of great pain. Hence the necessity of their prompt removal. In order to effect this the inside of the lids should be so exposed as to reveal the intruding substance. The lower lid may be easily turned down so as to show the inner surface, but the upper lid cannot be so easily manipulated. The end, however, may be attained by taking firm hold of the lid with the finger and thumb, drawing it downward and

forward, placing a quill or a small pencil-case on the outer upper part, and turning the lid backwards over it. When the annoying particle is seen it should be removed by gently drawing over it, with a wiping motion, a piece of rag or linen handkerchief, wrapped round the finger, or by means of a camel-hair brush, if this latter be at hand.

If lime-dust has blown into the eye it is only the larger particles that can be removed in this manner; the finer particles may be dissolved out by washing the eye with a lotion made of 1 part of common vinegar and 2 parts of water. A drop or two of pure sugar syrup will also frequently dissolve the lime. When a powerfully destructive substance, such, for instance, as sulphuric acid or oil of vitriol, is, as sometimes happens, thrown by some person into the eye, the best course is to wash it out with a solution containing 4 gr. of washing soda in 1 oz. of water. This should be done as quickly as possible, and pending the time the soda lotion is being got ready, the eye, being kept open, should be diligently washed with cold water. Grains of gunpowder should be carefully removed. Hot fluid, such as melted fat or pitch, may be got rid of by putting into the eye a few drops of almond or olive oil.

Upon removal of the foreign body the pain generally subsides; but it sometimes happens that the membranes may be lacerated, in which case more or less inflammation may ensue. Under these circumstances a medical practitioner should be consulted. For *animals*, the same treatment may be followed. See BLINDNESS, COLOUR-BLINDNESS, VISION, &c.

Eye Balsam, Vegetable. (*Martin Reichel*, Würzburg.) Opium, 5 parts; oxide of mercury, 5 parts; camphor, 2 parts; wax cerate, 52 parts (*Hager*).

Eyebright (*Euphrasia officinalis*, L.). A British plant, found in meadows and on heaths. It is astringent, and was formerly used in the preparation of an eye wash.

Eye Drops. See WATER (Eye).

Eye Essence. (*Dr Romershausen.*) A tincture prepared from fennel-seeds and fresh young fennel (*Hager*).

Eye Powder (*Laeyson*, Paris), also known as Odorous Powder. For the strengthening, restoration, and preservation of the sight. A powder composed of burnt chalk, 100 parts; ammonia, 50 parts; charcoal, 6 parts; oxide of iron, 2 parts; cinnamon bark, 2 parts (*P. L. Geiger*).

Eye Pow'ders. See COLLYRIA.

Eye Salt. Powdered alum (*G. Graefe*).

Eye Salve. See OINTMENT (Eye).

Eye Snuff. See SNUFF.

Eye Water. (*Biedermann*, Annaberg.) 2 grms. sulphate of zinc in 60 grms. distilled water, with a little infusion of cloves.

Eye Water (*Brun*) is a solution of 4 parts of aloes in 32 parts of white wine, with 32 parts of rose-water, and $1\frac{1}{2}$ parts of tincture of saffron.

Eye Water (*Chantomelanus*) 'makes spectacles superfluous.' A turbid yellow-brownish liquid, consisting of a weak extract of lavender flowers in diluted spirit, in which some oil of lavender has also been dissolved (*Opwyrda*).

Eye Water, Dr Graefe's. (*L. Roth*, Berlin.) Sulphate of zinc, 1·5 grms.; fennel-water, 100 grms., slightly coloured with fennel-seed tincture (*Schädler*).

Eye Water. (*J. P. H. Hette.*) A solution of ethereal oils of lavender, bergamot, rosemary, and tincture of opium in spirits of wine, 50% (*Wittstein*).

Eye Water (*Bernhard Kraft*, Calbe) for acute inflammation of the eyes and for strengthening the sight. 7 grms. of an impure muddy sediment-leaving spring water containing $\frac{1}{2}$ grm. of native sulphate of zinc containing iron (*Schädler*).

Eye Water. (*Inspector Stroinski*, Neisse.) 1 part of sulphate of zinc dissolved in 500 parts of common river water (*Schreiber*).

Once a trace of patchouli perfume was added to this water (*Hager*).

Eye Water, Dr White's. (*T. Ehrhard*, Altenfeld, Thuringia.) 4 cloves, a piece of cinnamon the size of a large pea, 2 teaspoonfuls of rose-water, 1 drop of vinegar, 10 drops of arnica tincture. Digest for an hour and filter. Dissolve in the filtrate some white vitriol of the size of a pea (*Hager*).

Sulphate of zinc, 3 parts; honey, 4 parts; water, 80 parts; perfumed with oil of cloves and a trace of mustard oil (*Wittstein*).

Eye Waters. See WATER.

FACE A'GUE. The common name for the intermittent form of facial NEURALGIA or TIC-DOULOUREUX. See NEURALGIA.

FACE PAINTS. *Syn.* FARDS, Fr. See BLOOM, CARMINE, PEARL WHITE, ROUGE, &c.

FAC-SIM'ILE. An exact imitation of an original in all its traits and peculiarities. The term is chiefly used in relation to copies of old manuscripts, or of handwriting, or of interesting documents, produced by engraving or lithography.

FACTI''TIOUS. *Syn.* FACTITIUS, L. Artificial; made by art, in distinction from that produced by nature. Numerous illustrations of the application of this word occur in the pages of the present work.

FÆ'CES. Excrement. In the *laboratory*, the 'settling' or sediment deposited by a liquor. See DEFECATION, EXCRETA.

FAINT'ING. *Syn.* SWOONING; SYNCOPE, DELIQUIUM ANIMI, L. In *pathology*, a state in which the respiration and circulation are apparently suspended for a time, or are extremely feeble. The symptoms are too well known to require description. The causes are supposed to be diminished energy of the brain, and organic affections of the heart or neighbouring vessels. This has led nosologists to divide syncope into two varieties:

1. *Occasional* (SYNCOPE OCCASIONALIS, S. ACCIDENTALIS, L.), primitively induced by sudden and violent emotions, powerful odours, derangement of the stomach or bowels, constrained position of the body, tight-lacing, pressure, loss of blood, debility from disease, &c. This variety is frequently followed by vomiting, and, occasionally, by convulsions. The recovery is accelerated by the horizontal position, the head being depressed, by which the arterial blood is more vigorously thrown upon the brain, and thereby stimulates it to re-

sume its usual functions. Pungent substances (smelling-bottle, vinaigrette, &c.) may be applied to the nostrils, and cold water sprinkled on the face and chest. In all cases the dress (corset, waist-band, neck-cloth, &c.) should be instantly loosened, and indeed this is the first assistance which should be given, either in syncope or apoplexy. As soon as the patient can swallow, a little brandy and water, or wine, or a few drops of ether or spirit of sal volatile, may be given.

2. *Cardiac* (SYNCOPE CARDIACA, L.), arising without any apparent cause, with violent palpitation during the intervals, and altogether of a more formidable character than the preceding. The subsequent treatment must here be directed to the cure or alleviation of the original disease.

FAINTS. The first and last runnings of the whisky-still. The one is technically termed the 'strong faints;' the other, the 'weak faints.' They are both purified by rectification, &c. See DISTILLATION.

FALLING SICK'NESS. See EPILEPSY.

FAMILIENSALBE, Family Ointment (*Göring*). 16 grms. of a hard yellow salve in a round box; a mixture of 9 parts wax, 3 parts fat, 2 parts turpentine, 2 parts inspissated juice of *Ornithogalum scilloides*, Jacquin, or *O. caudatum*, Aiton. These plants are known to the public as Meerzwiebel (sea onion or squill), but they are only related to that plant in appearance (*Hager*).

FARCY. See GLANDERS.

FARDEL-BOUND. *Syn.* CLUE-BOUND, MAW-BOUND, WOOD-EVIL. A disease of cattle usually attributed to impaction of indigestible material in the omasum or third stomach. Though this is generally found full of such material after death, Prof. Williams is of opinion that the disease is in reality 'abomasitis,' or inflammation of the mucous membrane of the true stomach.

The animals suffer from paralysis of the hinder parts, with convulsions, and often coma; in ruminants there is more or less diarrhœa, followed by obstinate constipation, not due to obstruction but to failure of the action of the intestines (*Williams*).

Treatm. Avoid the use of drastic purgatives. "Sedatives, aconite and belladonna, with carbonate of soda or potash, and one or at most two doses of an oleaginous aperient, an abundant supply of fluids to drink, fomentations to the abdomen, and enemata."

FARI'NA. The flour of any species of corn, pulse, tuber, or starchy root. The most important kinds of farina are noticed under their respective heads. The following dietetic articles of a farinaceous character are extensively advertised:

BAKER'S ALIMENTARY COMPOUND. Fine flour (pastrycook's), 2 parts; finely ground rice, 1 part.

BASTER'S COMPOUND FARINA. Wheat-flour, 14 oz.; white sugar, 2 oz.

BRADEN'S FARINACEOUS FOOD. Similar to Hard's (*below*).

BRIGHT'S BREAKFAST POWDER. Chocolate, 1 part; nutritious farina (*Bright's*), 2 parts.

BRIGHT'S NUTRITIOUS FARINA. Rice-flour and potato-starch, equal parts.

BULLOCK'S SEMOLA. Wheat-flour, from which a portion of the starch has been removed, so as to leave an excess of gluten.

DENHAM'S FARINACEOUS FOOD. Wheat-flour, 3 parts; barley-meal, 1 part; the mixture is slightly baked, and again ground and sifted. Said to be slightly laxative.

DURYEA'S MAIZENA. Indian-corn starch prepared for food.

GARDINER'S ALIMENTARY PREPARATION. Pure rice-flour, very finely ground.

HARD'S FARINACEOUS FOOD. Wheat-flour, slightly baked, and resifted.

KINGSFORD'S OSWEGO PREPARED CORN. An excellent preparation of Indian corn.

LEATH'S ALIMENTARY FARINA. Wheat-flour (baked), with some sugar, Indian-corn meal, and tapioca. According to some, it also contains potato-starch.

MAIDMAN'S NUTRITIOUS FARINA. Potato-starch tinged with beetroot or other pink colouring matter.

PLUMBE'S FARINACEOUS FOOD. South Sea arrowroot, with about 1-3rd its weight of pea-flour.

POLSON'S CORN FLOUR. The starch of Indian corn or maize prepared with great care. It is much used as a substitute for arrowroot, and for custards, puddings, &c.

SMITH'S NURSING FARINA. Equal parts of baked wheat-flour and rice-flour.

Obs. Many of the above compounds are deficient in the nitrogenous elements of nutrition, and all of them nearly destitute of the mineral and saline matters which are absolutely necessary to the formation of the bones and tissues, and the support of the body in health, and are consequently utterly unsuitable as an exclusive article of diet, especially for young children. As mere adjuvants or auxiliaries, when the natural food supplied by the mother may be insufficient for the nutrition of the infant, some of them may doubtless be of value; but in all other cases they should be largely combined with pure cow's milk, beef tea, meat broths or gravies, eggs, or other substances rich in the nitrogenous and saline elements of nutrition.

FAT. *Syn.* ADEPS, L. The fat of animals consists of an aggregation of globules of fatty or oily matter enclosed in an envelope of protoplasm, the remains of the cell, the degeneration of which has produced the fat. In digestion this envelope is dissolved and the fatty matter set free in a liquid state in consequence of the heat of the body. It is generally whitest and most copious in the well-fed young animal, and yellowish and more scanty in the old. That under the skin and surrounding the kidneys (suet) is also more solid than that in the neighbourhood of the moveable viscera. In the Cetacea, or whale tribe, the fatty secretion assumes the form of oil. These variations in consistency depend upon the relative proportions of solid stearin and liquid olein present in the fat.

The vegetable fats are found in various parts of certain plants, but are generally most abundant in the seeds. They are extracted by simple pressure or else by boiling. Two kinds of vegetable fat, namely, palm oil and cocoa-nut oil, are extensively employed in the *useful arts*.

All fats are lighter than water. They are all

soluble in ether, benzol, and turpentine, and may be mixed with each other in any proportion.

In former times the fats of many animals were employed in *pharmacy*, but at present those principally used are lard and suet. In *perfumery*, in addition to these, beef marrow and bear's grease are employed. For both these purposes the crude material is cut into small pieces, and freed as much as possible from all extraneous membranes; after which it is placed in a boiler with water, and heated until it is completely fused, when the whole is strained and allowed to cool very slowly. By this means a cake of cleansed fat is obtained, which may be readily separated from any adhering water.

Fats and the fat oils are best preserved by being run into glazed jars, and kept from the action of the air. A little benzoic acid or gum-benzoin, dissolved in them by heat, will generally prevent, and in all cases greatly defer, the accession of rancidity. See OIL, GLYCERIN, OLEIN, PALMITIN, STEARIN, TALLOW, &c., also *below*.

Fat, to melt down. Let all the small pieces of fat cut off joints, &c., be collected, divided into small pieces, put in a stew-pan (a little water being added to prevent their burning), and placed on the fire. This must be stirred carefully at intervals to prevent any of the pieces of fat sticking to the bottom.

When thoroughly melted (which it will be in about an hour and a half) pour through a strainer into a basin with some cold water in it. Thus prepared, dripping or fat may be used instead of suet, and there are few who would know any difference between them. Dripping, if clarified as above, may be used over and over again for frying, provided it has not been previously employed in dressing fish, in which case it will impart a fishy taste. But it can be used repeatedly for fish if it is kept for that purpose only. The skimmings off the top of the saucepans, while a piece of meat is boiling, will also do capitally for light puddings ('Artisan Cookery,' Griffith and Farran).

FATTY ACIDS. In *chemistry*, the acids of the acetic acid series; general formula $CnH_2n + {}_1.CO_2H$. They are called the 'fatty acids' because some of the members of the series occur, in combination with glyceryl, in the fats and oils. Palmitic acid is found in palm oil, and stearic acid in mutton suet. The lower acids can be distilled without decomposition, but the higher acids decompose unless they are distilled *in vacuo;* they all volatilise with steam. They dissolve readily in alcohol, and still more easily in ether. The general method of preparation of the lower acids is to oxidise the corresponding alcohol, while the higher acids are prepared from the fats. When fats are saponified by an alkali, stearate, palmitate, and oleate of potash or soda, as the case may be, are produced, and glycerin is set free. On decomposing either of these compounds with sulphuric acid a sulphate of the alkali is formed, and the fatty acid is precipitated. Some of the fatty acids, as stearic, cerotic, palmitic, and lauric, are solid at ordinary temperatures; others, as oleic, are liquid. The hard fatty acids are extensively used as candle materials, being superior in every respect to the natural fats from which they are derived.

FAVOURITE PRESCRIPTION (Dr Pierce's) for the cure of those chronic weaknesses and complaints peculiar to females. 280 grms. of a turbid greenish-brown fluid with a bulky deposit of the same colour, made according to the following recipe:—Savin tops, 10 grms.; larch, agaric, and cinnamon, of each, 5 grms.; China Jaën (ash cinchona bark), 10 grms.; boil with sufficient water to make 220 grms. when strained. Dissolve in the filtrate gum-arabic, 10 grms.; white sugar, 5 grms.; and add tinct. digitalis and tinct. opii, of each, 2 grms.; star-anise oil, 8 drops; 90% spirit, 45 grms. (*Hager*).

FEA'THERS. Ostrich feathers are those most esteemed as articles of personal decoration, and goose feathers for beds; but the feathers of other birds are commonly used for both purposes.

Feathers are prepared for ornamental purposes by scouring them with white soap-and-water (1 oz. to the pint), used hot; they are next well rinsed in several successive portions of pure water, and after being drained and shaken, are, lastly, passed through water slightly blued with pure indigo, and dried out of the dust. When dry the ribs are generally rubbed with a piece of glass, having a curved notch in it, for the purpose of increasing their pliancy, and the filaments are curled by drawing them between the edge of a blunt knife and the ball of the thumb of the hand which holds it.

Feathers, Bleaching of:

A new trade has sprung up within the past ten years by which black, brown, or grey feathers are bleached sufficiently to enable them to be dyed any required colour.

The process is as follows:—The feathers are first thoroughly washed with soap-and-water, to free them from any oil they may contain. They are next transferred to a bath composed of bichromate of potash dissolved in water, to which has been added a few drops of nitric or sulphuric acid. In this bath they rapidly lose their black, brown, or grey colour, and become almost white. On being removed from this bath they are well rinsed in water, and are then fit to be dyed even the most delicate colour. Great care is required in the process, as the flue of the feather is apt to be destroyed if kept too long in the bath. A bleached feather may be readily known by the yellow colour of its stem.

Other methods have been adopted, such as a bath of chloride of lime, peroxide of hydrogen, or sulphurous acid, &c., but the bichromate bath gives the best results.

Feathers, Dyeing of:

BLACK. By immersion for 2 or 3 days in a bath (at first hot) of logwood, 8 parts, and copperas or acetate of iron, (about) 1 part.

BLUE. With the indigo vat.

BROWN. By any of the brown dyes for silk or woollen.

CRIMSON. A mordant of alum, followed by a hot bath of brazil-wood, and afterwards by a weak one of cudbear.

PINK or ROSE. With safflower and lemon juice.

PLUM. The red dye, followed by alkaline bath.

RED. A mordant of alum, followed by a hot brazil-wood bath.

YELLOW. From an alum mordant, followed by a bath of turmeric or weld. Other shades may be obtained by a mixture of the above dyes.

Feathers may also be dyed by simple immersion, for 2 or 3 minutes, in a bath of any of the aniline colours.

Goose feathers for BEDS are generally PURIFIED by simply exposing them to the sun or in a stove until perfectly dry, and then beating them to remove loose dirt. When carelessly collected and dirty, they are sometimes first cleansed with lime-water, or, better still, with a weak solution of carbonate of soda, or water to which a little solution of chloride of lime has been added; after which they are rinsed in clean water and dried or stoved as before. Old feathers are cleansed or purified in the same way.

FEB'RIFUGES. *Syn.* FEBRIFUGA, L. In *pharmacy*, substances or agents which cure or alleviate fever. The term is more particularly applied to medicines used against the ague, as CINCHONA BARK and ARSENIOUS ACID, and their preparations. The extreme value of cold water as a drink in ardent fever has been known in all ages. In 1723 Dr Hancocke published a work entitled 'Febrifugum Magnum, or Common Water the best Cure for Fevers, and probably for the Plague,' which in a short time ran through several large editions, but appears to have been overlooked by the hydropaths of the present day.

FEC'ULA. *Syn.* FÆCULA, L. The matter which subsides from cold water in which bruised or rasped vegetable substances have been washed. The fecula obtained from the seeds of the cereals and Leguminosæ, and from tuberous or bulbous roots, consists of nearly pure STARCH. In some cases the starch is associated with the green colouring matter (CHLOROPHYLL) and the narcotic principles of the vegetables which yield it. The green fecula obtained by straining the expressed juices of the leaves and herbaceous parts of plants is of this character.

The fecula of all the amylaceous roots, rhizomes, and tubers, may be easily obtained, on the small scale, by rasping them, pressing, and working the pulp in cold water, and after straining the resulting milky liquid through a hair-sieve allowing it to settle. The sediment may be again washed by diffusion through clean cold water, and must be, lastly, collected, and dried out of the dust and without artificial heat.

The fecula of narcotic plants for medicinal purposes is obtained by allowing the expressed juice to repose for 24 hours, and then decanting the clear portion and drying the residue. Sometimes heat is employed. See ARROWROOT, STARCH, &c.

FEEDING-BOTTLES (To Clean). The closest attention must be paid to the cleaning of feeding-bottles. Each time after being used the whole apparatus should be well washed out with water containing a little soda in solution, and then thoroughly rinsed, first in warm, then in cold water.

"The inside of the cap must be carefully cleaned, and the brush should be carried several times through the whole length of the tubing. Afterwards the bottle and tubes should be laid in cold water until again wanted. An objection to the common brush usually supplied with each feeder is, that after a few days' use the softened bristles are apt to get detached and be caught in the joints of the tubing, whence they may afterwards be washed by the stream of fluid and be swallowed by the child. Accordingly, a new cleaner has been manufactured by Messrs Maw and Sons, in which bristles are entirely dispensed with. They are replaced by a thin strip of caoutchouc, which is wound round in a spiral form, at the end of the ordinary wire handle. This instrument answers all the purposes of a brush without the disadvantages alluded to, and is besides far more durable."

FEET (The). To preserve the feet in a proper condition, they should be frequently well washed in warm or tepid water. The nails of the toes should be pared, to prevent their becoming inconveniently long, and from growing into the flesh. Many persons suffer severely from TENDER FEET. This generally arises from the use of thin cotton or silk stockings, and boots or shoes that are either too tight or stiff, or not sufficiently porous to permit of the escape of the perspiration. Waterproof boots and shoes which are also air-tight (as those of gutta percha and india rubber) are common causes of tender feet, and even of headaches and dyspepsia. The best treatment of tender feet is the immediate adoption of worsted stockings or socks, and light easy shoes of buckskin, goatskin, or some other equally soft kind of leather. It is highly necessary for the preservation of health to preserve the feet DRY; persons who are, therefore, exposed to the wet, or who are frequently passengers through the public streets in bad weather, should regard sound and good boots and shoes as of the first importance. In fact, from a hygienic point of view, a wet back should be less shunned than wet feet. Many persons frequently experience EXTREME COLDNESS and NUMBNESS OF THE FEET. The best and most natural remedy for this is active exercise or friction, the former being always adopted when possible. In such cases the use of warm woollen stockings is absolutely necessary, and the debilitated and aged may advantageously keep them on throughout the night, or at all events until the feet acquire a comfortable degree of warmth. The DISAGREEABLE ODOUR which is evolved by the feet of some individuals in hot weather may be removed by the observance of extreme cleanliness, and by occasionally soaking the feet in warm water, to which a small quantity of chloride of lime or sal-ammoniac has been added. A good deodoriser for unpleasant smelling feet is said to be the following, invented by M. Paulcke:—A mixture of equal parts of salicylic acid, soap, talc, and starch, to be applied in the form of powder.

DISTORTION OF THE FEET is not uncommon in childhood, being sometimes congenital, but as frequently the result of weakness or bad nursing. When the child's feet are turned inwards it is called VARUS; when they are turned outwards it is styled VALGUS. The proper use of bandages, early applied, will generally correct these deformities; but if they be neglected in infancy they become

incurable, or necessitate surgical operation. CLUB-FOOT, of which there are several varieties, may also be frequently relieved by a simple surgical operation. See BOOTS AND SHOES, DISTORTIONS.

FELTING. This is a process by which various species of fur, hair, and wool are blended into a compact texture, in many respects resembling cloth. It depends on the peculiar anatomical construction of these substances, enabling them to interlace and intertwine with each other, by which they become permanently matted together. Felt was formerly chiefly employed for hats. It is now commonly used for mill-bands, filters, &c.; and when varnished or japanned, or saturated with asphalte or bitumen, is a durable substitute for japanned leather, and for roofing.

FENNEL. *Syn.* FŒNICULUM (Ph. L.), L. The fruit (seed) of *Fœniculum dulce*, or sweet fennel; the oil distilled from the fruit (OIL OF FENNEL; OLEUM FŒNICULI, L.), as well as a distilled water (FENNEL-WATER; AQUA FŒNICULI, L.), are officinal in the Pharmacopœias. They are stimulant and carminative, but are now seldom employed.

FENNEL-FLOWER SEEDS. From *Nigella sativa*, L., an annual, native of Southern Europe, Egypt, Levant, &c. When fresh the seeds have an odour like fennel, and an aromatic and slightly acrid taste. They are used as a spice by French cooks, in the East for flavouring curries, and as a carminative; also to protect linen against insects.

FEN'UGREEK. The seeds of *Trigonella fœnum-græcum*. Resolvent and stomachic. The seeds dye yellow; formerly roasted for coffee; now chiefly employed in *veterinary medicine*.

FERMENTATION. [FERVERE = to boil, L.] A term originally applied to the spontaneous decomposition of certain fluid or semi-fluid substances with disengagement of gas, especially to the result of the action of the yeast-plant upon a solution of sugar. Now that these and many analogous chemical changes are known to be produced by special organisms whose life processes result in certain more or less definite changes in the medium in which they live, the term has been applied to all such processes, and also to others occurring in the animal body during life which appear to be due, not to living organisms, but to certain unstable substances, or unorganised ferments as they are called, which are capable of exciting profound changes in the materials with which they are brought into contact, *e. g.* pepsin.

Any useful account of the various processes of fermentation would occupy an amount of space which the scope of this work would not justify, and the reader is referred to 'Fermentation,' by Schutzenberger ('Int. Science Series,' vol. xx), for a good general description of the phenomena.

Chemists have distinguished fermentation into different varieties, which, in general, are named after the more important products of its action. Of late years the number of these varieties has been greatly increased by the extension of the term to several operations besides those formerly included under it. Thus the vinous or alcohol-producing fermentation is accompanied, or caused, by two fungi, called *Torula cerevisiæ* and *Penicillium glaucum;* the acetous or vinegar-producing fermentation by *Torula aceti;* the lactous fermentation (souring of milk) by *Penicillium glaucum.* The butyric fermentation by an animal—an *infusorium* which cannot exist in free hydrogen, but flourishes in an atmosphere of oxygen, &c. See ACETIFICATION, BREAD, PUTREFACTION, BREWING, &c.

FERN (Male). *Syn.* MALE SHIELD FERN; FILIX MAS, RADIX FILICIS, L. The root (rhizome) of the *Lastræa filix-mas*, or male fern. It is bitter, astringent, or vermifuge.—*Dose*, 1 to 3 dr. in powder, or made into a decoction, repeated for 3 or 4 days, and followed by a purge. It is chiefly given in tapeworm. In Switzerland it is deemed almost infallible, but has proved less successful in these countries. See OILS.

FERRETS, Muzzle for. The following plan for 'coping' ferrets is in use in Warwickshire:—All that is required is a piece of tape and a little soft twine. The tape should be tied round the ferret's neck, so as to form a collar, and should be kept on permanently. When required for work make a single knot in the centre of a piece of twine, but do not have it taut. Open the ferret's mouth by pressing the sides of the jaws, and then slip the loop of the knot over the canine teeth in the lower jaw, and draw the knot close; bring the two ends over the nose, and make a double knot, slip one end of the twine through the collar, and knot both ends together. It requires a little practice to get the right tension in the knots; if they are too taut the twine will hurt the ferret, if too slack he will get his claws in the twine, and pull it off.

FERRICY'ANIDE. A double cyanide containing 1 molecule of ferric cyanide ($Fe(CN)_3$) united with the equivalent of 3 molecules of the cyanide of a monovalent metal, such as potassium. Thus potassium ferricyanide has the formula $K_3Fe(CN)_6$; *i. e.* $3KCN.Fe(CN)_3$.

The ferricyanides of AMMONIUM and the ALKALIES and ALKALINE EARTHS are soluble; those of most of the METALS insoluble. The most important ferricyanide is the potassium one, often called 'red prussiate of potash,' for which see POTASSIUM, FERRICYANIDE OF.

The characteristic *test* for ferricyanides is the blue precipitate (Turnbull's blue, $Fe_5(CN)_{12}$) which they give with solutions of ferrous salts, such as ferrous sulphate.

FERRICYAN'OGEN. The radical $Fe(CN)_6$ which exists in the ferricyanides. It is trivalent, and is thus distinguished from the isomeric radical ferrocyanogen, which is *tetra*valent. It has not been isolated.

FERROCY'ANIDE. A double cyanide containing 1 molecule of ferrous cyanide ($Fe(CN)_2$) united with the equivalent of 4 molecules of the cyanide of a monovalent metal, such as potassium. Thus potassium ferrocyanide has the formula $K_4Fe(CN)_6$; *i. e.* $4KCN.Fe(CN)_2$. The ferrocyanides of AMMONIUM and the ALKALIES and ALKALINE EARTHS are soluble; those of the other metals are for the most part insoluble. The most important is the potassium salt, often called 'yellow prussiate of potash,' for which see POTASSIUM, FERROCYANIDE OF. Ferrocyanides are characterised by their giving a finely divided blue precipitate (Prussian blue, $Fe_7(CN)_{18}$) with solutions of ferric salts, such as ferric chloride.

FERROCYAN'OGEN. The tetravalent radical $Fe(CN)_6$, which exists in ferrocyanides. It has not been isolated. Its isomeride ferricyanogen is *tri*valent.

FERRU'GO. [L.] Rust of iron. See IRON (Sesquioxide).

FE'VER. *Syn.* FEBRIS, PYREXIA, L. In *pathology*, a condition characterised by loss of appetite, thirst, languor, debility, unwillingness to move, accelerated pulse, increased heat of surface and of the normal temperature of the body, and general disturbance of all the functions. See AGUE, TYPHOID, TYPHUS FEVER, &c.

FEVER DROPS (C. Warburg's Vegetable). Camphor and aloes, 2½; orange peel, 10; elecampane root, 12; digest with 90% spirit 240, mixed with ac. sulphuric. dil. 24. To the tincture add quinine sulphate, 9; tinct. opii crocatæ, 2½ (*Ragsky*).

FEVER POWDERS (James's, also called James's Powder and Pulvis Jacobi). It consists essentially of phosphate and antimoniate of lime with free antimonic acid.

FI'BRIN. *Syn.* FIBRINE. An azotised substance, forming the coagulable portion of fresh-drawn blood, and the principal constituent of the muscular or fleshy parts of animals.

Prep. Fibrin is easily obtained in a nearly pure state by agitating or beating newly drawn blood with a small bundle of twigs, when it attaches itself to the latter under the form of long reddish filaments, which become white when worked with the hands in a stream of cold water. The colouring matter of the blood is best removed by washing in water containing 0·75% of common salt. It may also be procured by washing the coagulum of blood, tied up in a cloth, in cold water, until all the soluble portions are removed. A small quantity of fat which it still contains may be removed by digesting it in ether.

Prop., &c. Pure fibrin occurs as long, white, elastic filaments, which are tasteless, inodorous, and insoluble in both hot and cold water. Wetted with acetic acid it forms, after a time, a transparent jelly, which is slowly soluble in pure water. Very dilute solutions of the caustic alkalies dissolve it completely, and the new solution greatly resembles liquid albumen. Dried by a gentle heat it loses about 80% of water.

FIG. *Syn.* FICUS (B. P., Ph. L., E., & D.), CARICA, CARICÆ FRUCTUS, L. The figs of commerce are the dried fruit of *Ficus carica*, the common fig-tree. They are demulcent, emollient, laxative, and pectoral. Roasted and boiled figs are occasionally employed as poultices to gumboils and other affections of the mouth.

FILARIA DRACUNCULUS. See GUINEA WORM.

FILARIA SANGUINIS HOMINIS. In 1872, Dr T. R. Lewis, in examining microscopically the blood and urine of some of his patients in India, discovered a worm enveloped in an extremely delicate tube, closed at both ends, within which it could either elongate or shorten itself. This parasite (called from its principal habitat the *Filaria sanguinis hominis*) is about $\frac{1}{75}$ of an inch in length, and about $\frac{1}{3500}$ of an inch in diameter. When removed from the body with a small quantity of blood, it is described as being in a state of incessant motion, unceasingly coiling and uncoiling itself, lashing the blood-corpuscles in all directions, and insinuating itself between them.

The worms are said, when first taken from the body, to present a translucent appearance; the larger specimens, however, frequently exhibit an aggregation of granules towards the junction of the lower and middle half. Occasionally a bright spot, suggestive of a mouth, is seen at the thicker extremity. It is stated that they continue active from six to thirty hours. Mr Lewis does not believe they are able to perforate the tissues.

"These parasites," says Mr Lewis, "are so persistently ubiquitous, as to be obtained day after day by simply pricking any portion of the body, even to the tips of the fingers and toes of both hands and both feet of one and the same person, with a finely pointed needle. On one occasion six excellent specimens were obtained in a single drop of blood by merely pricking the lobule of the ear."

Dr Lewis estimates, from the number of the Filaria found in one drop of the blood of one patient, that his body must have contained more than 140,000. The presence of these creatures in the blood is believed to be the cause of chylous urine, which is a very common disease in the East. It seems probable they gain admission into the body from being present in drinking water.

FIL'BERT. *Syn.* FILBERD. The fruit of the cultivated hazel or nut-tree (*Corylus avellana*). Filberts are distinguished from common nuts by their lengthened figure and larger size. The best are imported from Spain.

FILES. The manufactures of these articles do not come within the limits of this work. It may, however, be useful to mention that FILES, FLOATS, and RASPS, which 'cut dull' from age, dirt, or being much worn, are greatly improved by being kept wet, immersed in water for some hours, or even for a day or two.

Mr Ernest Spon recommends the following method for renovating files:—The file to be first cleansed from all foreign matter, and then dipped in a solution of 1 part of nitric acid, 3 parts of sulphuric acid, and 7 parts of water; the time of immersion will be according to the extent the file has been worn and the fineness of the teeth, varying from 5 seconds to 5 minutes. On taking it out of the mixture, wash in water, then dip in milk of lime, wash off the lime, dry by a gentle heat, rub over equal parts of olive oil and turpentine, and finally brush over with powdered coke.

FIL'TER. *Syn.* FILTRUM, L. An instrument or apparatus for straining or filtering liquids.

FIL'TERING POWDERS. *Prep.* 1. Fuller's earth, washed, dried without heat, and reduced to coarse powder.

2. Pipe-clay or potter's clay, as the last. Both the above are used to filter and bleach oils.

3. Clay or fuller's earth, 1 part; fine siliceous sand, 2 parts; the two are separately washed, after which they are drained and mixed together, and dried as before. Used for GLUTINOUS OILS.

4. Granulated animal charcoal, sifted and fanned from the dust. Used to filter and bleach SYRUPS and VEGETABLE SOLUTIONS.

Obs. Filtering powders are prepared of several degrees of coarseness, and should be chosen with reference to the degree of fluidity of the liquid to be filtered through them. In no case should they be reduced to fine powder, as not only is the process of filtration thereby rendered unnecessarily tedious, but in some cases (as when charcoal dust is mixed with glutinous vegetable solutions and syrups) the filtrate carries off a portion of the powder, which can afterwards be separated from it only with considerable difficulty. See CHARCOAL, FILTRATION, OIL, &c.

FILTRA'TION. *Syn.* FILTRATIO, L. The separation of liquids from substances mechanically suspended in them, by passing them through media having pores sufficiently fine to retain or keep back the solid matter. Filtration is one of the most common and useful of the chemico-mechanical operations of the arts, and its successful performance in an economical and expeditious manner is therefore a matter of the highest importance in the laboratory, and, indeed, in almost every branch of human skill and industry, in which liquids are employed. Simple in principle, and apparently easily performed, it is, nevertheless, one of those operations which require no less of care than of tact and experience to conduct it with certainty and success. The losses sustained in the laboratory by defective manipulation in this particular often exceed those arising from ignorance and accidents in every other department conducted in it.

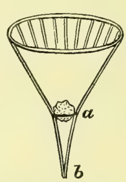
Filtration is generally resorted to for the purpose of freeing liquids from feculence, dirt, and other foreign matter, and for obtaining them in a clear or transparent state; but, in some cases, it has for its object the collection of the suspended substances, as precipitates, &c., and in others both these intentions are combined. The word 'filtration' is absolutely synonymous with 'straining,' but in the language of the laboratory it is usually applied to the operation of rendering liquids transparent, or nearly so, by passing them through fine media, as filtering paper, sand, and the like; whilst the term 'straining' is employed to designate the mere separation of the grosser portion by means of coarse media, flannel, horsehair, cloth, &c., through which they flow with considerable rapidity. Filtration is distinguished from 'clarification' by its mere mechanical action, whereas the latter operates by depuration, or the subsidence of the suspended substances or fæces, arising from their gravity being naturally greater than the fluid with which they are mixed, or being rendered so by the application of heat, or by the addition of some foreign substance.

The apparatus, vessels, or media, employed for filtration, are called 'FILTERS,' and are technically distinguished from 'STRAINERS' by the superior fineness of their pores.

Both strainers and filters act on the same principles as the common sieve on powders; they all, in like manner, retain or hold back the coarser matter, and permit the liquid or smaller and more attenuated particles to pass through. The term 'medium' is applied to the substance or substances through the pores of which the liquid percolates.

The form of filters, and the substances of which they are composed, are various, and depend upon the nature of the liquids for which they are intended. On the small scale, funnels of tin, zinc, copper, wedgwood-ware, earthenware, glass, or porcelain, are commonly employed as the containing vessels (see fig. 1). The filtering medium may be any substance of a sufficiently spongy or porous nature to allow of the free percolation of the liquid, and whose pores are, at the same time, sufficiently small to render it limpid or transparent. Unsized paper, flannel, linen, calico, cotton wool, felt, sand, coarsely powdered charcoal, porous stone, or earthenware, and numerous other substances of a similar kind, are employed for this purpose.

FIG. 1.



For many liquids that filter easily, and in which the suspended matter is of a coarse and porous nature, it is often sufficient merely to place a little cotton wool or tow, or a small piece of sponge, in the neck of the funnel, as at *a* (fig. 1); but such an apparatus, from the small extent of the filtering surface, acts either slowly or imperfectly, and soon gets choked up. Filters of unsized paper are well suited for all liquids that are not of a corrosive or viscid nature, and are universally employed for filtering small quantities of liquids in the laboratory. A piece of the paper is taken of a size proportionate to the quantity of the liquid to be filtered, and is first doubled from corner to corner into a triangle (see fig. 2, *a*), which is again doubled into a smaller triangle (*b*), and the angular portion of the margin being rounded off with a pair of scissors (*c*), it constitutes a paper cone, which is placed on a funnel of the proportionate capacity, and is then nearly filled with the liquid. A piece of paper so cut, when laid flat upon the table, should be nearly circular. Filtering paper is now sold ready cut in circles of various sizes, which simply require doubling for use. Another method of forming a paper filter, preferred by some persons, is to double the paper one as above, and then fold it in a similar way to a fan, observing so to open it and lay it on the funnel that a sufficient interval be left between the two to permit of the free passage of the filtered liquid on its descent towards the receiver. The 'plaited filter,' as thus formed, is exceedingly useful for general purposes; it exposes the entire surface of the paper to the liquid, and allows filtration to proceed more rapidly than a 'plain filter' does (see fig. 3).

FIG. 2.

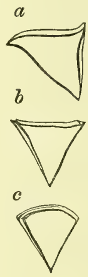
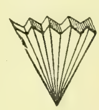


FIG. 3.

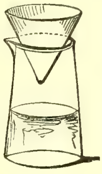


Mr Rother recommends the following plan as securing more rapid filtration. Cut the circular disc of filtering paper in two through the line of its diameter, take either half-disc, and fold it across the line of the radius, then turn down the double edge of the cut side and fold it over

several times; finally, run a hard smooth surface along the seam thus produced, to compress it, and spread the finished filter into an appropriate funnel, first moistening it with water before the liquid to be filtered is poured in.

In reference to funnels, it may be remarked that those employed for filtering rapidly should be deeply ribbed on the inside, or small rods of wood or glass, or pieces of straw or quills should be placed between them and the paper. The neck or tubular part of the funnel should, in like manner, be deeply ribbed or fluted on the outside, to permit of the free passage of the air, when it is placed in a narrow-mouthed bottle or receiver. When this is not the case, filtration proceeds but slowly, and the filtered liquid is apt to be driven up the outside of the neck of the funnel by the confined air, and to be continually hissing and flowing over the mouth of the vessel. The breadth of a funnel, to filter well, should be about 3-4ths its height, reckoning from the throat (*a*). When deeper, the paper is liable to be continually ruptured, from the pressure of the superincumbent fluid; and when shallower, filtration proceeds slowly, and an unnecessarily large surface of the liquid is exposed to the atmosphere, and is lost by evaporation. To lessen this as much as possible, the upper edge of the glass is frequently ground perfectly smooth, and a piece of smooth plate-glass is laid thereon. When paper filters are of large dimensions, or employed for aqueous fluids that rapidly soften the texture of the paper, or for collecting heavy powders, or metallic precipitates, it is usual to support them on linen or calico, to prevent them breaking. This is best done by folding the cloth up with the paper, and cutting the filter out of the two, in the same way as would be done with doubled paper, observing so to place it in the funnel that the paper and calico may remain close together, especially towards the bottom.

The filtration of small quantities of liquid, as in chemical experiments, may often be conveniently performed by placing the paper on the circular top of a recipient (see *engr.*), or on a ring of glass or earthenware laid on the top of any suitable vessel. A filter of this kind that will hold 1 fl. oz. will filter many ounces of some liquids in an hour.

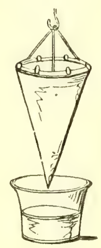


Good filtering paper should contain no soluble matter, and should not give more than $\frac{1}{250}$ to $\frac{1}{230}$ of its weight of ashes. The soluble matter may be removed by washing it, first, with very dilute hydrochloric acid, and secondly, with distilled water.

The 'Munktell' Swedish filtering paper (Dr F. Mohr says that Swedish filtering paper is now undeserving its traditional reputation, and that it contains soluble alumina) is composed of flax fibres very much crushed and broken, and owes its value to the broken pieces of the fibres filling up the pores, and thus preventing solids from passing through the paper. Rhenish filtering paper is also made from flax, but, in consequence of the more perfect condition of its fibres, is more porous than Munktell's, and therefore inferior to it for filtering purposes. Another kind of Rhenish paper, also of flax, in which the fibres are much torn, is manufactured, and is said to be a useful article, and to allow the rapid passage of fluids through it. The white filtering papers of English make have a small quantity of cotton mixed with the flax; and the fibres are much torn and crushed; hence they make serviceable filters.

The grey, circular-cut filtering paper of varying sizes, of foreign make, as well as the grey sheet filtering paper of Dutch and English manufacture, contains a large quantity of wool, much of which is coloured; as well as jute and esparto grass, both of these latter in an unbleached state. The amount of ash in the Munktell paper has of late increased in quantity (*Greenish*).

For filtering a larger quantity of a liquid than can be conveniently managed with a funnel, and also for substances that are either too viscid or too much loaded with feculence to allow them to pass freely through paper, conical bags made of flannel, felt, tweeled cotton-cloth or Canton flannel, linen or calico, and suspended to iron hooks by rings or tapes, are commonly employed. The first two of the above substances are preferable for saccharine, mucilaginous, and acidulous liquors; the third for oily ones; and the remainder, for tinctures, weak alkaline lyes, and similar solutions. These bags have the disadvantage of sucking up a considerable quantity of the fluid poured into them, and are therefore objectionable, except for large quantities, or when they are to be continued in actual use as filters for some time. On the large scale, a number of them are usually worked together, and are generally enclosed in cases to prevent evaporation, and to exclude dirt from the filtered liquor that trickles down their sides. These arrangements will be noticed further on.



A simple mode of filtering aqueous fluids, which are not injured by exposure to the air, is to draw them off from one vessel to another by means of a number of threads of loosely twisted cotton or worsted, arranged in the form of a syphon (see *engr.*). The little cotton rope at once performs the operations of decantation and filtration. This method is often convenient for sucking off the water from a small quantity of a precipitate.

For fuller information on the subject of laboratory filtration the reader is referred to the following papers (which are too long for quotation here) in the 'Chemical News:'

"On a New Mode of Filtration," by J. B. Cooke, May 30th, 1873; "Filtering Apparatus," by John F. Kerr, February 6th, 1874; "Implements for Filtration," by P. Casamajor, July 23rd and July 30th, 1875; *ibid.*, by W. Jago, February 4th, 1876; "On Rapid Filtration," by E. C. H. Hildebrand, August 11th, 1876; also to 'Journal of the Chemical Society' for papers on "Simple Suction Arrangement for Rapid Filtering," by C. Holthof, vol. xxxii, part 2, p. 508;

"Employment of Compressed Air on Filtering Solutions," by W. Leübe, vol. xxxii, part 1, p. 270.

When solid substances, as porous stone or earthenware, are used as the media for filtrations, vessels of metal, wood, or stoneware are employed to contain them and the supernatant liquid. In these cases the filtering medium is usually arranged as a shelf or diaphragm, and divides the vessel into two compartments; the upper one being intended to contain the dirty liquid, and the under one to receive the same when filtered. Such an apparatus is set in operation by merely filling the upper chamber, and may at any time be readily cleared out by reversing it and passing clean water through it in an opposite direction. Small arrangements of this kind, intended to be screwed on to the water-supply pipe by either end, and which answer the purpose intended in the most satisfactory manner, have been manufactured and vended under the name of 'REVERSIBLE' or 'SELF-CLEANING FILTERS.' When pulverulent substances, as sand, coarsely powdered charcoal, &c., are employed, a similar arrangement is followed; but in this case the shelf or diaphragm must consist of any convenient substance pierced with numerous holes, over which must be placed first a stratum of coarse pebbles, next some of a finer description, and on this a proper quantity of the sand, charcoal, or other medium. Over the whole should be placed another layer of pebbles, or a board or plate of metal or earthenware, pierced with a number of holes to allow the liquid to be poured into the filter without disturbing its arrangement. Apparatus of this kind, of a permanent description, and arranged for filtering large quantities of liquids, are properly denominated 'FILTERING MACHINES.'

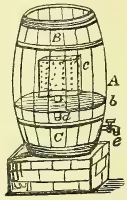
Among the liquids usually submitted to filtration, the following may be mentioned as the principal: water, oils, syrups, tinctures, vegetable juices, infusions, and decoctions.

The filtration of water may now be considered. The water of our wells is presented by nature ready filtered to the hand of man, and often exhibits an admirable degree of transparency and purity. It acquires this state by percolating through the mineral strata of the earth, which deprives it of the organic matter it derives from the soil and subsoil, but, at the same time, it dissolves a portion of the saline and earthy media through which it passes, and hence acquires that peculiar 'hardness' which is constantly found in spring water. On the large scale, this natural system of filtration has been imitated by some of the commercial companies that supply our cities and towns with water. Extensive beds of sand and gravel have been employed, with variable success, as the filtering media; and were it not that filters gradually lose their porosity by the accumulation of the retained matter in their pores, such a method would be excellent. But the great expense of such filters precludes the possibility of frequently cleaning or renewing them, by which means they can alone be kept in an efficient state.

A filter which possesses the advantages of being easily and cheaply cleaned when dirty, and which frees water from mechanical impurities with immense rapidity, may be formed by placing a stratum of sponge between two perforated metallic plates, united by a central screw, and arranged in such a manner as to permit of the sponge being compressed to any required degree. Water, under gentle pressure, flows with such rapidity through the pores of compressed sponge that it is said that a few square feet of this substance will perfectly filter several millions of gallons of water daily. This method of filtration has been made the subject of a patent.

A few barrels or hogsheads of water may be easily filtered daily by the arrangement represented in the engraving.

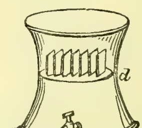
It is evident that when water is poured into the upper portion (B) of a vessel, so arranged, it will



A. A common water-pipe or cask.
b. A false bottom fitting in perfectly water-tight.
c. A perforated wooden or metallic vessel or box covered with a bag of felt or other filtering substance (not shown in the engraving).
d. A small tube, fitting water-tight into the false bottom and uniting the *interior* of the filter with the lower portion (C) of the cask.

sink through the filter (c) and pipe (d) into the lower chamber (C), and this filtration will go on as long as the supply continues, and water is drawn from the cock (e). By uniting the cock (e) with a tank or casks, and by keeping the upper portion (B) always full by means of a ball-cock, a considerable quantity of water may be thus filtered. The advantage of this plan is, that the filter (c) can be always readily got at, and easily cleaned or renewed.

For filtering water on the small scale, and for domestic use, 'alcarazzas,' diaphragms of porous earthenware and filtering-stone and layers of sand and charcoal, &c., already referred to, are commonly employed as filtering media. The filtering power of porous stone or earthenware may be greatly increased by adopting the arrangement represented in the margin, which consists in making the diaphragm of the shape of a disc (d), supporting plates of the same material, the whole forming but one piece. The 'PLATYLITHIC WATER-FILTERS,' which are formed of porous stone cut on this plan, present 200 to 300 square inches of filtering surface. A cheap, useful form of portable filter is the following, given in the 'Proceedings of the British Association:' "Take any common vessel, perforated below, such as a flower-pot, fill the lower portion with coarse pebbles, over which place a layer of finer ones, and on these a layer of clean coarse sand. On the top of this a piece of burnt clay, perforated with small holes, should be put, and on this again a stratum of 3 or 4 in. thick of well-burnt pounded animal charcoal. A filter thus formed will last a considerable time, and will be found particularly useful in removing noxious and putrescent substances held in solution by water." The 'PORTABLE FILTERS,' set up in stoneware, that are commonly sold in the shops, contain a



stratum of sand or coarsely powdered charcoal; before, however, having access to this, the water has to pass through a sponge, to remove the coarser portion of the impurities. Among the many new kinds of portable filters now offered for sale, which claim special notice, are the following, viz.:

1. The MOULDED CARBON FILTER, consisting of a spherical or cylindrical vessel formed of compressed carbon.

2. The SILICATED CARBON FILTER, in which the medium is a compact substance, formed of animal charcoal and the ashes of Boghead coal.

Of the many forms of this filter we may mention the 'Syphon Filter for Travellers,' by means of which wholesome water may be drunk from any pond or stream by simply immersing the filter therein and drawing the water through the tube by suction. Of the 'Silicated Carbon Filter,' Professor Wanklyn says that it will render river water containing a considerable amount of free and albuminoid ammonia as pure as deep spring water.

3. BISCHOFF'S PATENT SPONGY-IRON FILTER. This differs from one invented many years ago by Dr Medlock, in bringing the water into contact with spongy iron instead of thin iron rods, and thus effecting filtration much more rapidly. Medlock believed that the iron rods brought about the oxidation of the nitrogenous organic matter, and its consequent conversion into nitrites and nitrates. Bischoff states that he has experimentally investigated the properties of spongy iron, and finds that it—

a. Decomposes even distilled water, which has been previously boiled.

b. That it reduces nitric acid to ammonia.

c. That the amounts of organic nitrogen and albuminoid ammonia are always much reduced after filtration through spongy iron.

d. That a minute quantity of iron is dissolved by the carbonic acid contained in the water, ferrous bicarbonate being formed. The latter being soon oxidised and precipitated is easily removed by filtration.

e. That the action of spongy iron on impure water is twofold, viz. chemical and mechanical. "The chemical action is clearly indicated by the decomposition of water. The readiest explanation for the decomposition of water is the intimate contact between the electro-positive and electro-negative bodies, such as metallic iron and carbon, or even metallic iron and any ferric oxide which has escaped reduction, or which has been re-oxidised by exposure to air or water; and it may well be supposed that, consequent to the galvanic current thus produced, the atmospheric oxygen dissolved in water is ozonised, and caused to act as a powerful oxidising agent in organic matter."

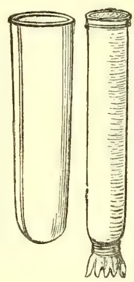
4. The so-called MAGNETIC CARBIDE OF IRON FILTER. In this, the filtering material is said to be prepared by heating hematite with sawdust. This filter has a good repute.

5. One of the best household filters in the market is Maignen's 'Filtre Rapide,' which consists essentially of a layer of charcoal spread over the surface of a felt bag, which may be turned inside out and thoroughly cleaned with great ease.

Cleansing of Filters. Every 2 or 3 months (according to the kind of water) air should be blown through, and if the charcoal be in the block form it should be brushed. Then 4 to 6 oz. of the pharmacopœial solution of potassium permanganate, or 20 to 30 gr. of the solid permanganate in a quart of distilled water, and 10 drops of strong sulphuric acid should be poured through, and subsequently $\frac{1}{4}$ to $\frac{1}{2}$ oz. of pure hydrochloric acid in 2 to 4 galls. of distilled water. This plan would be useful on foreign stations where the filter cannot be sent home or taken to pieces; if it can be taken to pieces, the charcoal should be spread out in a thin layer, and exposed for some time to air or sun, or heated in an oven.

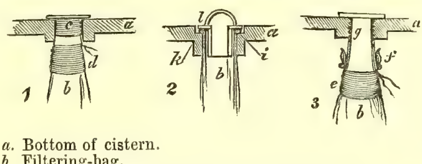
If sponges are at all used, they should be removed very frequently, and thoroughly washed in hot water.

Oils are filtered, on the small scale, through cotton-wool, or unsized paper, arranged in a funnel; and on the large scale, through long bags, made of tweeled cotton-cloth (Canton flannel). These bags are usually made about 12 or 15 inches in diameter, and from 4 to 8 feet long (see *engr.*), and are enclosed in bottomless casings, or bags of coarse canvas, about 5 to 6 or 8 inches in diameter, for the purpose of condensing a great extent of filtering surface into the smallest possible space. A number of these double bags (from 1 to 50 or 60) are connected with corresponding holes in the bottom of a block-tin or tinned-copper cistern, into which the oil to be filtered is poured. The mode in which these bags are fastened to the cistern is of the utmost importance, as on the joint being close and secure depends the integrity of the apparatus. Three methods of doing this are figured in the engraving, which, with the references, will explain themselves, the same letters referring to the same parts of each.



Filtering-bag of cotton-cloth.

Cotton filtering-bag, '*creased*,' or enclosed in its canvas envelope, ready for fixing.



a. Bottom of cistern.
b. Filtering-bag.
c. Screw of the conical nozzle fitting into the cistern.
d. Binding cord connecting bag and nozzle.
e. Binding cord connecting bag and lower nozzle.
f. Bayonet-catch, connecting the lower portion of the nozzle fastened to the bag with the upper and fixed part (*g*).
i. The thick hem at the top of the bag (purposely made large by enclosing a piece of thick cord therein), resting on the shoulders (*k*).
l. A metallic cylinder, loosely fitting the hole in the cistern, and over which the top of the bag is drawn, before being put into its place; when fitted, as in the engraving, it retains the hem (*i*) securely in its place above the shoulder (*k*).

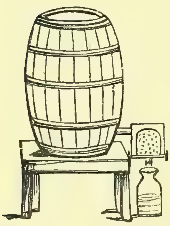
The second of the above arrangements is the least expensive, and certainly the most convenient in practice; and when the cylinder (*l*) fits the

hole closely (allowing for the bag), is as safe, or safer than an ordinary screw.

The bags are surrounded by a wooden screen fitted up with doors for the purpose of keeping off the dust; and the bottom of the apartment is furnished with large steam-pipes, by which a proper temperature may be kept up in cold weather. The use of heat should, however, never be had recourse to when it can be avoided, as although it vastly increases the rate of filtration, the oil so filtered is more apt to become opaque in cold weather than when the process is conducted at the natural temperature of the atmosphere. This is particularly the case with castor oil and sperm oil. In the United States of America, where the latter is consumed in enormous quantities for illumination, the best is always 'winter strained,' as it is popularly called. In practice, it is more convenient to have a number of small cisterns at work (say 50 or 100 galls. each), than one or two larger ones, as any accident that may occur is more easily remedied, and that without stopping the whole operation.

When cotton-cloth bags are employed without being 'creased,' or enclosed in others of canvas, they should not be longer than about 3 or 4 feet, and not wider than about 5 or 6 inches when filled. When larger they are dangerous.

A convenient method of filtering a single cask of oil is, to insert the pipe of a two-way patent filter into the cork-hole, by which means the whole will be filtered as drawn off, without any trouble on the part of the operator. This filter consists of a porous bag stretched over a perforated metallic vessel, nearly the shape and size of the exterior casing, and its edge is tightly screwed between the sides and bottom of the latter, so as to be quite water-tight. The cock communicates with the interior of the perforated plate and the supply-pipe with the exterior. By this means the interior chamber, which occupies 5-6ths of the vessel, rapidly fills with filtered oil, and continues full as long as any liquor remains in the cask. This arrangement is also well adapted to the filtration of wines, beer, cordials, porter, and various other liquors. It is unequalled in simplicity and usefulness. The same filter may be removed from cask to cask, with the facility of a common cock.



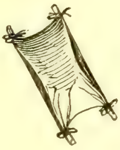
The filtration of SYRUPS is now generally effected on the large scale by passing them through the 'CREASED BAG FILTER' just described. On the small scale, as employed by confectioners and druggists, they are usually passed through CONICAL FLANNEL BAGS. The filtration of thick syrups is, however, attended with some difficulty, and it is therefore a good plan to filter them in a somewhat dilute state, and afterwards to reduce them to a proper consistence by evaporation in clean vessels of tinned copper by steam heat. Syrups, when filtered in a heated state, run well for a time, but the pores of the fabric rapidly get choked from the thickening of the syrup and partial crystallisation of the sugar, occasioned by the evaporation of the aqueous portion on the surface of the bag. This may be partially prevented by enclosing the bag in a metallic casing. On the whole clarification is preferable for syrups to filtration on the small scale. They need only be well beaten up while cold with a little white of egg, and then heated; a scum rises, which must be removed as soon as it becomes consistent, and the skimming continued until the liquid becomes clear. Any floating portions of scum that may have escaped notice are easily removed by running the syrup through a coarse flannel strainer whilst hot. The most extensive application of the process of filtration in the *arts* is in the refining of sugars.

TINCTURES and DILUTE SPIRITS are usually filtered, on the small scale, through BIBULOUS or UNSIZED PAPER placed on a funnel; and, on the large scale, through thin and fine COTTON BAGS. In general, however, tinctures clarify themselves by the subsidence of the suspended matter when allowed to repose for a few days. Hence it is the bottoms alone that require filtering; the supernatant clear portion need only be run through a small hair-sieve, a piece of tow or cotton placed in the throat of a funnel, or some other coarse medium, to remove any floating substances, as pieces of straw, &c. Spirits which are largely loaded with essential oil, as those of ANISEED, &c., run rapidly through paper or calico, but usually require the addition of a spoonful or two of magnesia before they will flow quite clear. When possible, tinctures, spirits, and all similar volatile fluids, are better and more economically cleared by subsidence or clarification than by filtration, as, in the latter way, a portion is lost by evaporation, and the strength of the liquid is thereby altered.

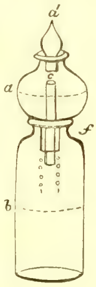
Vegetable juices should be allowed to deposit their feculous portion before filtration. The supernatant liquid will then be often found quite clear. It is only when this is not the case that filtration should be had recourse to. A small quantity may be filtered through coarse or woollen filtering paper, supported on a piece of coarse calico placed on a funnel; when the quantity is large, one of the CONICAL BAGS before described should be employed. The bottoms from which the clear portion has been decanted should be placed on a separate filter, or else not added until the whole of the other portion has drained through. Vegetable juices are often rendered clear by simply heating them to about 180° or 200° F., by which their albumen is coagulated; they are also frequently clarified by the addition of a little white of egg and heat, in the same way as syrups. Many of them (as those of hemlock, henbane, aconite, &c.) are greatly injured by heat, and must consequently be filtered, or only simply decanted after repose. In all cases they should be exposed to the air as little as possible, as they rapidly suffer decomposition.

Vegetable infusions and decoctions may be cleared by defecation followed by filtration. The conical bags of flannel before described are usually employed for this purpose. When the liquid is to be evaporated to an extract, they are commonly suspended by a hook over the

evaporating pan. A convenient method of straining these fluids, practised in the laboratory, is to stretch a square of flannel on a frame or 'horse,' securing it at the corners by pieces of string (see *engr.*). Such a frame, laid across the mouth of a pan, is more easily fed with fresh liquid than a bag, whose mouth is 40 or 50 inches higher. The same purpose, for small quantities of liquid, is effected by laying the flannel across the mouth of a coarse hair-sieve. The concentrated infusions and decoctions being usually weak tinctures, may be filtered in the same way as the latter (see *above*). Many vegetable solutions, that from viscidity of the suspended matter can scarcely be filtered, may be readily clarified with white of egg in the cold, or pass the filter rapidly if a very small quantity of acetic, tartaric, sulphuric, or other strong acid is previously added.



Corrosive liquids, as the STRONG ACIDS, are filtered through powdered glass, or SILICEOUS SAND, supported on pebbles in the throat of a glass funnel, or through asbestos or gun-cotton placed in the same manner. Charcoal has also been employed for the same purpose, but is not fit for some acids. Strong caustic alkaline lyes are also filtered through powdered glass or sand. Weak alkaline lyes may be filtered through fine calico, stretched across the mouth of a funnel. Many corrosive liquids, as solution of potassa, &c., require to be excluded from the air during filtration. The simplest apparatus that can be employed for this purpose is that figured in the margin: (*a*) is a globular bottle fitted with the ground stopper (*d*), and having a perforated neck (*f*) ground to the bottle (*b*); (*c*) is a small tube, wrapped round with as much asbestos, linen, or calico as is required to make it fit the under neck of the bottle through which it passes. The tube (*c*) may also be fixed by placing the pebbles and powdered glass or sand round it, as before mentioned. For use, the solution to be filtered is poured into the bottle (*a*) nearly as high as the top of the tube (*c*), and the stopper is replaced. The liquid then descends into (*b*), and a similar quantity of air passes up into the tube (*a*). LIQUOR POTASSÆ may be always obtained fine by depuration in close vessels, when the sediment of lime only need be filtered, which may be effected with calico fixed across the mouth of a funnel.



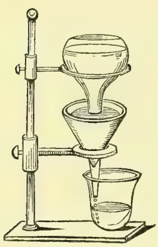
When a precipitate, or the suspended matter in a liquid, is the object of the filtration, the filter should be of such a nature that the powder may be easily separated from it when dry, and that with the least loss possible. Linen filters are for this reason preferable for large quantities, and those of smooth bibulous paper for small ones. The powder should be washed down the sides of the filter and collected, by means of a small stream of water, in one spot at the bottom, assisting the operation with a camel-hair pencil; and when the whole is dry, it should be swept off the paper or cloth with a similar pencil or brush, and not removed by a knife, as is commonly done, when it can be possibly avoided.

Carbonised sawdust, saturated with chemicals, has been introduced into Germany as a filtering and decolourising material. Sawdust is treated first with alum, then with sodium carbonate, and becomes impregnated with a precipitate of aluminium hydrate, which firmly adheres to it. After being washed with a solution of barium chloride until no precipitate is given, the sodium sulphate simultaneously produced is entirely removed, and the prepared sawdust is ready for use. Coloured liquids filtered with it have their colour entirely removed by the formation of lakes with the aluminium hydrates present in the filtering material. Sawdust saturated in this way with barium chloride is used for filtering liquids, from which it is required to remove calcium sulphate, and a sawdust treated with magnesium sulphate and caustic soda is used to remove calcium carbonate from a solution.

The 'first runnings' of liquid from a filter are commonly foul, and are pumped back or returned until the fluid runs perfectly limpid and transparent, when it is 'turned into' the 'filtered liquor cistern' or proper receiver. In many cases the liquid does not readily become transparent by simply passing through the filter; hence has arisen the use of FILTERING POWDERS, or substances which rapidly choke up the pores of the media in a sufficient degree to make the fluid pass clear. In the employment of these powders care should be taken that they are not in too fine a state of division, nor used in larger quantities than are absolutely necessary, as they are apt to choke up the filter and to absorb a large quantity of the liquid. The less filtering powder used the more rapid will be the progress of the filtration, and the longer will be the period during which the apparatus will continue in effective action. For some liquids these substances are employed for the double purpose of decolouring or whitening as well as rendering them transparent. In such cases it is preferable first to pass the fluid through a layer of the substance in coarse powder, from which it will 'run' but slightly contaminated into the filter; or, if the powder is mixed with the whole body of the liquid, as in bleaching almond oil, &c., to pass the mixture through some coarser medium to remove the cruder portion before allowing it to run into the filter. Another plan is, after long agitation and subsequent repose, to decant the clearer portion from the grosser sediment, and to employ separate filters for the two. Granulated animal charcoal is used, according to the first method, to decolour syrups, oils, &c.; and filtering powder, by the second and third, to remove a portion of the colour and to clarify castor and other oils. The common plan of mixing large quantities of filtering powder with castor oil and throwing the whole into the filter, as adopted by the druggists, is injudicious. When simple filtration is required it is better to use little or no powder, and to continue returning the oil that 'runs' through until, by the swelling of the fibres of the filter-bags, it flows quite clear. By

this plan the same filters may be used for a long period of time (for many years), and will continue to work well; whilst, by the usual method, they rapidly decline in power, and soon deliver their contents slowly, and after a short time scarcely at all.

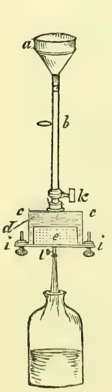
It is often of great advantage to render a filter 'self-acting,' or to construct it in such a way that it may 'feed itself,' so that it may continue full and at work without the constant attention of the operator. On the small scale, this may be readily effected on the principle of the common fountain lamp (see *engr.*); and on the large scale, by placing the vessel containing the unfiltered liquid on a higher level than the filter, and by having the end of the supply-pipe fitted with a ball-cock, to keep the liquid in the filter constantly at the same height.



The rapidity of filtration depends upon the porosity of the filtering medium, the extent of the filtering surface, the relative viscidity or mobility of the filtering liquid, the pressure or force by which the liquid is impelled through the pores of the filter, and the porosity and fineness of the substances it holds in suspension. The most efficient filter is produced when the first two or the first three are so graduated to the others that the liquid filters rapidly, and is at the same time rendered perfectly transparent.

In the common method of filtration no pressure is exerted beyond that of the weight of the column of the liquid resting on the filtering medium, but in some cases additional pressure is employed. This is had recourse to for the purpose of producing a more rapid filtration, and more especially for filtering liquids that, from their viscidity, will scarcely pass through the pores of substances sufficiently fine to remove their impurities in the ordinary way.

One of the easiest means of employing pressure in filtration is to increase the height of the column of the filtering liquid. From the peculiar properties of fluids, by which they transmit pressure in an equal degree in all directions, this column need not be of equal diameter throughout, but may be conveniently contracted to the size of a small pipe, as in the accompanying engraving, which represents a small filter on this construction at work:—(*a*) is the funnel or reservoir of foul liquid; (*b*) a small pipe conveying the liquid to the filter; (*c c*) a chamber, of which the upper portion (*d*) is filled with the descending liquid, and the lower portion (*e*) with the filtering media; (*i i*) are screws by which the bottom plate is fastened on, which plate is removed to clean out or renew the filter. For use, the cocks (*k*) and (*l*)are closed, and liquid poured into the funnel (*a*); the cock (*k*) is next opened, and, in a few minutes after, the cock (*l*), when an uninterrupted flow of filtered liquor will be obtained as long as any fluid remains in the funnel (*a*) and the tube (*b*). The length of the tube determines the degree of pressure. Care must be taken first to pass the foul liquid through a hair-sieve, or some other strainer, to remove any substance that might choke up the pipe (*b*).



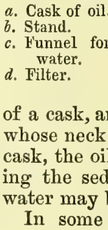
Another method of employing pressure in filtration is the withdrawal of the air from the receiving vessel, as in the vacuum filter, by which a pressure of about 14½ lbs. to the square inch becomes exerted on the surface of the liquid by the atmosphere. The vacuum in the receiving vessel may be produced by the air-pump, by steam, or by the Bunsen or Sprengel pump.

A commoner method of applying pressure than either of those already mentioned is to condense the air over the surface of the liquid by means of a forcing-pump, or by steam.

On the small scale, pressure may be applied to filtration by means of a syphon, whose shorter leg has its mouth blown into the shape of a bell or funnel, over which filtering paper or fine calico may be stretched.

The application of pressure to filtration is not always advantageous, and beyond a certain limit is generally attended with inconvenience, if not with absolute disadvantage. It is found in practice that fluids under pressure take a longer period to run clear than without pressure, and that ruptures of the media more frequently take place in the former case, or with pressure, than in the latter. Great pressure is in no case advantageous.

The filters already noticed are those that act by the fluid descending through the media; but in some cases the reverse method is employed, and the liquid filters upwards instead of downwards. These are called ascending filters, and are often preferable to those on the descending principle, because the suspended matters that require removal by filtration usually sink, and thus a portion escapes being forced into the pores of the filter. They are also more convenient when pressure is employed. The construction depends upon the same principles as the common filter, and merely requires that the feeding vessel should be higher than the upper surface of the filtering media. Oils are conveniently filtered in this way, because of their little specific gravity. By fixing a small filter on this principle into the head of a cask, and pouring in water through a funnel, whose neck reaches nearly to the bottom of the cask, the oil will float up and pass the filter, leaving the sediment behind. In cold weather hot water may be employed.



a. Cask of oil.
b. Stand.
c. Funnel for water.
d. Filter.

In some cases the upward and downward systems of filtration are united in the same apparatus, and this plan is advantageous where the space for operating is limited. For this purpose it is merely necessary to connect the bottom of an ascending filter with the top of a descending one, or the reverse; the proper pressure being in either case applied. See Air-Pump, Bunsen's Water-

AIR-PUMP; CLARIFICATION; DEFECATION; FININGS, &c.

FI'NINGS. Substances used by publicans, brewers, wine merchants, &c., to clarify their liquors. See BREWING.

FIRE. It has been proposed at various times to make certain additions to the water used for the purpose of extinguishing fires, in order to render its action more certain and effective. It is found that sal-ammoniac (5 oz. to the gall.) exerts this property in a remarkable degree. Several other articles, as common salt, pearlash, and kitchen soda, act in the same way, though less effectively. A few buckets of such water will speedily arrest the progress of a fire before it has much extended itself. Such a plan is easily applied by adding the saline matter to the buckets of water, which are either used by hand or to feed the engine for the first few minutes of its working. When, however, a fire has made much progress, the action of such substances becomes scarcely perceptible.

Chimneys on fire are readily extinguished in several ways, without having recourse to throwing water down them from the top, by which much damage is frequently done to the furniture in the rooms. One of the simplest methods is to cautiously scatter a handful of flowers of sulphur over the dullest part of the burning coals; the sulphurous vapours, being incapable of supporting combustion, rapidly extinguish the flames. Another method is to shut the doors and windows, and to stop up the bottom of the chimney with a piece of wet carpet or blanket, throwing a little water or flowers of sulphur, or even common salt, on the fire immediately before doing so. By this means the draught is stopped, and the burning soot extinguished for want of air. In many of the first-class houses recently erected 'fireplace shutters' are provided, which, when partly drawn down, act as powerful bellows or 'blowers,' and which, when wholly drawn down, so as to touch the hearthstone, entirely close up the fireplace, and instantly extinguish the combustion of the fuel in the grate, or that of the soot in the chimney. This simple arrangement, the advantages of which were pointed out in an early edition of this work, renders fires in chimneys of little moment, as it is only necessary to draw down the shutter to put them out. If a chimney is stopped at top, instead of at the bottom, the whole of the smoke must, of necessity, be driven into the apartment.

In France, M. Marateuh has successfully applied the principle of Davy's safety lamp for the prevention of fires in chimneys. He places fire-frames of iron-work near the base of the chimney, one above the other, about one foot apart; no flame passes through them, whilst the draught in the chimney is not interfered with, the result being that no fire can happen in the chimney.

Escape from apartments on fire may be best effected by creeping on the hands and knees. In this way the window or door may be reached. It is found that the atmosphere of a room so full of smoke as to produce suffocation to a person standing upright may generally be safely breathed on nearly a level with the floor. A damp cloth or handkerchief, tied over the mouth and nostrils, or, still better, over the whole face and head, will enable a person to effect a passage through the densest smoke, and, in many cases, to escape from buildings on fire when otherwise it would be impracticable. Should descent by the staircase be found impossible, then the window should be immediately sought, and a ladder or fire-escape waited for. In the absence of either, if the danger is imminent, a rope should be made by tying the sheets and blankets of the bed together, one end of which should be firmly secured to a chair or table, or preferably to one of the bedposts, and with this apparatus descent should be cautiously attempted. Jumping out of the window should be avoided, as persons who have not been brought up as clowns or harlequins run just as much danger in performing such an exploit as they do by remaining in the burning building. When it is impossible to escape from a burning building by the stairs or windows, retreat may be sometimes secured by a trap-door opening on to the roof, or by a skylight, when, unless it be an isolated house, the roof of one of the adjoining buildings may probably be gained with safety.

It is said that there is no instance on record of a person being burnt to death in a dwelling-house in Edinburgh, where the houses are usually high; yet in London, where fire-engines and fire-escapes are provided in greater numbers, deaths are very frequent from this cause. The reason of this difference is that in the former city the stairs are all made of stone, by which means a road of escape is secured.

The clothes of females and children, when on fire, may be most readily extinguished by rolling the sufferer in the carpet, hearth-rug, table-cover, a great-coat, cloak, or any other woollen article at hand. If this be expertly done the flames may be rapidly put out, unless the skirts of the dress be distended by hoops or crinoline, when there is great difficulty in staying the progress of the flames. Should assistance not be at hand, the person whose clothes are on fire should throw herself on the ground and roll the carpet round her, as before described; or if such a thing is not in the room, she should endeavour to extinguish the flames with her hands, and by rapidly rolling over and over on the floor. In this way the fire will be stifled, or at least the combustion will proceed so slowly that less personal injury will be experienced before assistance arrives. The advantage of assuming the horizontal position is manifest from the fact that nine times out of ten it is the lower parts of the dresses of females that first catch fire.

Fire Anni'hilator (*Phillips's*). This is essentially a gaseous engine, which at any moment can be made to discharge a stream of mixed gases and vapours having the power of checking combustion. When first introduced it was generally regarded as a most important invention, but it has not proved an effective substitute for the common water-engine. For extinguishing fires on board ship and in close apartments it is undoubtedly well adapted, but as a street engine it is comparatively useless, owing to the unmanageable nature of its fire-annihilating vapours.

The composition with which the 'Fire Annihilator' is charged is a mixture of dried ferro-

cyanide of potassium, sugar, and chlorate of potassa. It is set in action by a blow on a glass vessel containing oil of vitriol, which, being fractured, permits the acid to flow over the 'charge,' when the anti-combustion gas is liberated, and rushes forth with great impetuosity.

Fire-damp. See HYDROGEN (Light Carburetted).

Fire-engine. The common fire-engine is a compound forcing-pump, consisting of two 'forcing-pumps' placed on opposite sides of an 'air-vessel,' with which both communicate. The 'fulcrum' of the 'lever' by which both pumps are worked is placed midway between them; consequently they act alternately in charging the air-vessel. In order to obtain a very forcible jet it is necessary to prevent the escape of any portion of the contents of the air-vessel until the confined air is considerably compressed. The lever is connected with hand-rails on each side of the engine, and these are alternately raised and depressed by the workers. Engines worked by steam-power are now common in London and most of our large towns.

Fire-extinguishing Powder (Feuerlosch-pulver). (*Bucher*, Leipzig.) Nitre, 59 parts; sulphur, 36 parts; coal, 4 parts; iron oxide, 1 part (*Wittstein*).

Fire, how to light a. In a close stove the first thing is to empty the fireplace. Take out the larger cinders and half-burnt coal with your fingers, and lay them on one side for lighting the fire; then rake out all the ashes (this can be done with the lids on, then it will not make so much dust). Next take off all the lids, and sweep all the soot carefully out; once or twice a week the flue-pipe must be taken off and cleared out, also the flues under the oven. The soot should be carried away at once, as it blows about. Then black-lead the stove; put in a few cinders, lay on them a piece of paper and a few sticks crossing each other; on these lay very lightly some pieces of half-burnt coal and a few cinders, leaving space for the draught.

Do not fill the grate full; put the lids on, draw out the damper, light the fire, and shut the front door. An open fire is lighted in much the same way. There are no flues to clean out; but the chimney, as high as one can reach and behind the register door, should be cleared from soot daily ("Household Management, &c.," by W. T. Tegetmeier).

Fire-proofing. See INCOMBUSTIBILITY, &c.

Fireworks. See PYROTECHNY, and *below*.

FIRES. (In *pyrotechny*.) Coloured fires may be termed, not inaptly, the *chefs-d'œuvre* of the pyrotechnist's art, since on their excellence the attractions of most other varieties of fireworks depend. The following forms, under judicious management, yield fires of remarkable beauty.

Fire, Blue. *Prep.* 1. From metallic antimony, 1 part; sulphur, 2 parts; nitre, 5 parts.

2. From realgar, 2 parts; charcoal, 3 parts; chlorate of potassa, 5 parts; sulphur, 13 parts; nitrate of baryta, 77 parts.

3. (*Mr A. Bird.*) Charcoal and orpiment, of each, 1 part; black sulphuret of antimony, 16 parts; nitre, 48 parts; sulphur, 64 parts.

4. (*Fownes.*) Tersulphuret of antimony, 1 part; sulphur, 2 parts; dry nitre, 6 parts. This is the composition used for the Benga or blue signal-light employed at sea.

5. (*Prof. Marchand.*) Sulphur, sulphate of potassa, and ammonio-sulphate of copper, of each, 15 parts; nitre, 27 parts; chlorate of potassa, 28 parts. For theatrical illuminations. This may be rendered either lighter or darker coloured by lessening or increasing the quantities of the sulphate of potassa and ammonio-sulphate of copper.

6. (LIGHT BLUE, *Marchand.*) Sulphur, 16 parts; calcined alum, 23 parts; chlorate of potassa, 61 parts.

7. (DARK BLUE, *Marchand.*) Calcined alum and carbonate of copper, of each, 12 parts; sulphur, 16 parts; chlorate of potassa, 60 parts.

8. (*Marsh.*) Sulphate of copper, 7 parts; sulphur, 24 parts; chlorate of potassa, 69 parts.

9. (*Ruggieri.*) Nitre, 2 parts; sulphur and zinc, of each, 3 parts; gunpowder, 4 parts.

10. From sulphur, 1 part; dried verdigris, 2 parts; chlorate of potassa, 9 parts.

Fire, Crimson. *Prep.* 1. (*Marsh.*) Chlorate of potassa, $4\frac{1}{4}$ parts; charcoal (alder or willow), $5\frac{3}{4}$ parts; sulphur, $22\frac{1}{2}$ parts; nitrate of strontia, $67\frac{1}{2}$ parts. For pots.

2. (*Marsh.*) Charcoal, $4\frac{1}{4}$ parts; sulphuret of antimony, $5\frac{1}{2}$ parts; chlorate of potassa, $17\frac{1}{4}$ parts; sulphur, 18 parts; nitrate of strontia, 55 parts. For boxes and stars.

3. (*Marchand.*) Sulphur, 16 parts; chalk (dry), 23 parts; chlorate of potassa, 61 parts. Turns on the purple. See RED FIRE (*below*).

Fire, Green. *Prep.* 1. Nitrate of baryta, 77 parts; chlorate of potassa, 8 parts; fine charcoal, 3 parts; sulphur, 13 parts.

2. From metallic arsenic, 2 parts; charcoal, 3 parts; chlorate of potassa, 5 parts; sulphur, 13 parts; nitrate of baryta, 77 parts. Very beautiful, particularly when burnt before a reflector.

3. (*Mr A. Bird.*) Charcoal and black sulphuret of antimony, of each, 2 parts; chlorate of potassa, 5 parts; sulphur, 6 parts; nitrate of baryta, 80 parts.

4. (*Fownes.*) Lamp-black, 1 part; chlorate of potassa, 4 parts; sulphur, 6 parts; dry nitrate of baryta, 18 parts.

5. (*Marchand.*) Boracic acid, 10 parts; sulphur, 17 parts; chlorate of potassa, 73 parts. Very beautiful.

6. (*Marchand.*) Chlorate of potassa, 18 parts; sulphur, 22 parts; nitrate of baryta, 60 parts. For theatrical illuminations.

7. (LIGHT GREEN, *Marchand.*) Sulphur, 16 parts; carbonate of baryta, 24 parts; chlorate of potassa, 60 parts. Extremely delicate.

8. (*Marsh.*) Charcoal and sulphuret of arsenic, of each, $1\frac{3}{4}$ parts; sulphur, $10\frac{1}{2}$ parts; chlorate of potassa, $23\frac{1}{4}$ parts; nitrate of baryta, $62\frac{1}{2}$ parts. For pots or stars.

Fire, Lilac. *Prep.* 1. (*Marsh.*) Black oxide of copper, 6 parts; dry chalk, 20 parts; sulphur, 25 parts; chlorate of potassa, 49 parts. For pans.

2. (*Marsh.*) From black oxide of copper, 3 parts; dried chalk, 22 parts; sulphur, 25 parts; chlorate of potassa, 50 parts. For stars.

Fire, Orange. See RED FIRE, No. 8 (*below*).

Fire, Pink. *Prep.* (*Marchand.*) Charcoal, 1

part; chalk and sulphur, of each, 20 parts; chlorate of potassa, 27 parts; nitre, 32 parts. For theatrical illuminations. See RED FIRE, No. 10 (*below*).

Fire, Purple. *Prep.* 1. From lamp-black, realgar, and nitre, of each, 1 part; sulphur, 2 parts; chlorate of potassa, 5 parts; fused nitrate of strontia, 16 parts.

2. (*Marsh.*) Sulphuret of antimony, 2¾ parts; black oxide of copper, 10 parts; sulphur and nitrate of potassa, of each, 22¾ parts; chlorate of potassa, 42 parts. For pans.

3. (*Marsh.*) Sulphate of copper, 9¾ parts; sulphur, 13 parts; chlorate of potassa, 77¼ parts. For stars.

4. From sulphur, 12 parts; black oxide of copper, 12 parts; chlorate of potassa, 30 parts. See CRIMSON FIRE, No. 3 (*above*), and RED FIRE, No. 9 (*below*).

Fire, Red. *Prep.* 1. From sulphur, sulphuret of antimony, and nitre, of each, 1 part; dried nitrate of strontia, 5 parts.

2. (*Mr. A. Bird.*) Charcoal, 1 part; black sulphuret of antimony, 4 parts; chlorate of potassa, 5 parts; sulphur, 13 parts; dried nitrate of strontia, 40 parts.

3. (*Fownes.*) Lamp-black, 2 parts; chlorate of potassa, 8 parts; sulphur, 9 parts; dried nitrate of strontia, 32 parts.

4. (*Marchand.*) Sulphur, 16 parts; carbonate of strontia, 23 parts; chlorate of potassa, 61 parts.

5. (*Marchand.*) Chlorate of potassa, 20 parts; sulphur, 24 parts; nitrate of strontia, 56 parts. For theatrical illuminations.

6. (*Marsh.*) Coal-dust, 2 parts; gunpowder, 6 parts; sulphur, 20 parts; dried nitrate of strontia, 72 parts.

7. (*Ruggieri.*) Sulphuret of antimony, 4 parts; chlorate of potassa, 5 parts; sulphur, 13 parts; fused nitrate of strontia, 40 parts. A little charcoal or lamp-black makes it burn quicker.

8. (ORANGE RED, *Marchand.*) Sulphur, 14 parts; chalk, 34 parts; chlorate of potassa, 52 parts.

9. (PURPLE RED, *Marchand.*) Sulphur, 16 parts; chalk, 23 parts; chlorate of potassa, 61 parts.

10. (ROSE RED, *Marchand.*) Sulphur, 16 parts; dried chloride of calcium, 23 parts; chlorate of potassa, 61 parts. See PINK FIRE.

11. From charcoal, 2 parts; chlorate of potassa, 6 parts; sulphur, 13 parts; dried nitrate of strontia, 40 parts.

Fire, Violet. *Prep.* 1. From charcoal, 8 parts; sulphur, 10 parts; metallic copper, 15 parts; chlorate of potassa, 30 parts.

2. (DARK VIOLET, *Marchand.*) Alum and carbonate of potassa, of each, 12 parts; sulphur, 16 parts; chlorate of potassa, 60 parts.

3. (PALE VIOLET, *Marchand.*) Sulphur, 14 parts; alum and carbonate of potassa, 16 parts; chlorate of potassa, 54 parts.

Fire, White. *Prep.* 1. From nitre, 60 parts; sulphur, 20 parts; black antimony, 10 parts; meal powder, 6 parts; powdered camphor, 4 parts. For either pans or stars.

2. (*Mr A. Bird.*) White arsenic, 1 part; charcoal, 2 parts; black antimony, 16 parts; nitre, 48 parts; sulphur, 64 parts.

Green-coloured Fires (*Kern*, 'Chemical News,' September 29th, 1876).

No.	Potassium Chlorate, per cent.	Barium Nitrate, per cent.	Sulphur, per cent.
1	36	40	24
2	29	48	23
3	24	53	23
4	21	57	22
5	18	60	22
6	16	62	22
7	14	64	22
8	13	66	21
9	12	67	21
10	11	68	21
11	10	69	21
12	9·5	69·5	21
13	9	70	21
14	8·5	70·5	21
15	8	71	21

Red-coloured Fires.

No.	Potassium Chlorate, per cent.	Strontium Nitrate, per cent.	Sulphur, per cent.	Carbon Powder, per cent.
1	40	39	18	3
2	32	46	19	2
3	27	51	20	2
4	23	55	20	2
5	20	58	20·5	1·5
6	18	60	21	1
7	16	61·6	21·2	1·2
8	15	63	21	1
9	13	64	22	1
10	12	65	22	1
11	11	66	22	1
12	10	67	22	1
13	10	67·25	22	0·75
14	9·25	68	22	0·75
15	9	68·35	22	0·65

Violet-coloured Fires.

No.	Potassium Chlorate, per cent.	Calcium Carbonate, per cent.	Malachite, Powdered, per cent.	Sulphur, per cent.
1	52	29	4	15
2	52	28	5	15
3	52	26	7	15
4	52	24	9	15
5	52	23	10	15
6	52	21	13	15
7	51	20	14	15
8	51	18	16	15
9	51	16	18	15
10	51	15	19	15
11	51	13	21	15
12	51	11	23	15
13	51	10	24	15
14	51	8	26	15
15	51	6	28	15

3. (*Marchand.*) Charcoal, 2 parts; sulphur, 22 parts; nitre, 76 parts. For theatrical illuminations.

4. (*Marchand.*) Gunpowder, 15 parts; sulphur, 21 parts; nitre, 64 parts. As the last.

5. (*Marsh.*) Gunpowder, $12\frac{1}{2}$ parts; zinc filings, 18 parts; sulphur, 23 parts; nitre, $46\frac{1}{2}$ parts. For pans.

6. (*Marsh.*) Zinc dust or filings, 15 parts; sulphur, 28 parts; nitre, 57 parts. For stars.

7. (*Ruggieri.*) Sulphur, $13\frac{1}{4}$ parts; sulphuret of antimony, $17\frac{1}{4}$ parts; nitre, 48 parts.

8. (*Ruggieri.*) From realgar, 2 parts; sulphur, 7 parts; nitre, 24 parts.

9. (*Ruggieri.*) Charcoal, 1 part; sulphur, 24 parts; nitre, 75 parts.

10. (*Ruggieri.*) Iron or zinc borings, 25 parts; gupowder, 100 parts.

Fire, Yellow. *Prep.* 1. From sulphur, 16 parts; dried carbonate of soda, 23 parts; chlorate of potassa, 61 parts.

2. (*Marchand.*) Gunpowder, 14 parts; sulphur, 16 parts; dried soda, 20 parts; nitre, 50 parts.

3. (*Marchand.*) Charcoal, $1\frac{1}{2}$ parts; sulphur, $17\frac{1}{2}$ parts; dried soda, 20 parts; nitre, 61 parts.

4. (*Marsh.*) Charcoal, 6 parts; sulphur, $19\frac{1}{2}$ parts. For pans. Very beautiful.

In preparing coloured fires for fireworks according to the usual formulæ given in manuals of pyrotechny, it is often important to know the speed at which they burn; as in some cases, such as decorations and lances, they should burn slowly, whereas in others, such as wheels, stars for rockets, and Roman candles, they ought to burn quicker. The foregoing tables are so arranged that every formula with a higher number yields a slower burning mixture than one with a lower number. Thus No. 5 burns quicker than No. 6, and slower than No. 4.

Obs. The ingredients in the above compounds are to be separately reduced to powder and sifted through lawn, after which they should be kept in well-corked wide-mouthed bottles until the time of mixing them for use. The chlorate of potassa, more especially, must be separately treated and cautiously handled, in order to prevent the possibility of explosion from friction whilst it is in contact with combustible matter. The requisite quantity of each of the ingredients being weighed out and placed on a clean sheet of white paper, the whole is to be thoroughly but carefully mixed together with a light hand, by means of a bone or wooden knife. The compound is next lightly packed into small cups or pans for illuminations, or into small pill-boxes for stars and trains, a little priming and quick-match being lastly attached to each. To ensure success the several ingredients must be dry and commercially pure; and though reduced to the state of a uniform powder, care must be taken that they are not absolutely 'dusty,' or too finely pulverised. The nitrate of strontia, alum, saltpetre, carbonate of soda, &c., before being weighed, require to be gently heated in an iron pot or pan until they fall to powder, and lose their hygrometric moisture, or water of crystallisation. To ensure the perfect admixture of the ingredients, the whole, after they have been stirred together on paper, as before directed, may be passed through a hair or perforated zinc or brass sieve. Further, as coloured fires rapidly deteriorate by keeping and even sometimes inflame spontaneously, to prevent disappointment and accidents they should not be prepared long before they will be required for use, and should be stored in some situation in which their spontaneous combustion would be productive of no disastrous consequences.

Of the above formulæ, those bearing the name of the late Mr Marsh, of Woolwich, more especially deserve the attention of the pyrotechnist. To guard against the danger sometimes arising from the spontaneous combustion of coloured fires containing sulphur and chlorate of potash, Mr Saunders recommends intimately mixing 120 gr. of bicarbonate of potash with each pound of sulphur before using it in the manufacture of any composition into which chlorates enter. See FLAME, PYROTECHNY, &c.

FISH. *Syn.* PISCES, L. As food fish are undoubtedly wholesome and nutritious, although less so than the flesh of animals or the grains of the cereals. Of all the various substances used as aliments by man, fish are, however, the most liable to putrefaction, and should therefore be only eaten when perfectly fresh, or, if not recently taken, then only when their perfect preservation has been ensured by any of the ordinary methods employed for the purpose. Those that are the whitest and most flaky when cooked, as cod, flounders, haddock, hake, soles, turbot, whiting, &c., are the most easily digested; and those abounding in oily matter, as eels, herring, mackerel, salmon, &c., are most nutritious, though the most likely to offend the stomach. Salt-water fish have been said to be more wholesome than river fish, but without sufficient reason. Salted fish are hard of digestion, unless when carefully cooked and well masticated. Skin diseases are said to be more common among those who live continually on fish than among those who abstain from it; but this probably arises from their use being unaccompanied by a proper quantity of fresh vegetables or fruit, both of which are scarcer on the sea-coast than further inland. As one of the components of a mixed diet, the value of fish is indisputable.

Artificial Propagation. The fecundity of fish is positively marvellous. According to the recent observations of Mr Frank T. Buckland, salmon yield about 1000 ova or eggs to every lb. of their weight; a trout weighing 1 lb. produced upwards of 1000; a mackerel (1 lb.), 86,120; a herring ($\frac{1}{2}$ lb.), 19,840; a sole (1 lb.), 134,466; a turbot (8 lbs.), 385,200; and a cod (20 lbs.), 4,872,000. The ova here spoken of form what is commonly called the 'hard roe' of the female fish; the 'soft roe' is 'the milt' of the male fish. To protect the spawn and the fry, when hatched, is the object of the art of fish-culture, which has made great progress during late years. When the spawn is not artificially protected, the greater portion is always wasted, being swept away by the stream and devoured by fish, birds, and insects. The natural enemies of the newly hatched fish are, again, so numerous, that it is really surprising that any should escape destruction. According to

given data and accurate returns of the fisheries made by Messrs Ashworth and Buist, only one salmon egg out of every 1000 deposited ever becomes a fish fit for human food. Other fish, both fresh and salt water, suffer in proportion. The hatching of fish by artificial means has been carried out on a large scale in France, and has been commenced in Scotland and Ireland, and on a small scale in England. The spawning fish having been caught by a net, is made to deposit her eggs by gently pressing on the abdomen; these are impregnated by 'milt' expressed from the male fish in a similar manner, and mixed with them in a shallow tub or other vessel prepared for the purpose. The impregnated eggs are placed in long shallow boxes, bottomed with gravel and pebbles, and so arranged that a small stream of water from a reservoir may flow from one to another. The time of hatching depends entirely upon the temperature of the water, from 40°—45° F. seems to be the healthiest temperature. After about 50 days (in the case of the salmon), when all goes well, the young fish makes its appearance as a misshapen creature about 1 inch long, with a bag containing the yelk of the egg attached to its abdomen. At 3 days the old fry is about 2 gr. in weight; at 16 months it has increased to 2 oz. To preserve the young fish in health, the box must be covered with shades of slate or zinc. The French fish-breeders generally feed the young fry with boiled frogs powdered fine. The Scotch give boiled liver. Mr Buckland prescribes a diet of roe of sole, or plaice, or whiting. As to the age at which it is advisable to turn young fish out of the nursery, there is much difference of opinion. Some breeders recommend turning them out as soon as the 'umbilical bag' is absorbed; others think they should be taken care of till they are older and stronger, and better able to defend themselves or escape from attack. For full details respecting the artificial propagation of fish, the reader is referred to Mr Buckland's recent work, entitled 'Fish-Hatching.'

Nutritive Value of Fish. The white varieties of fish, such as *whiting, cod, haddock, sole, plaice, flounder,* and *turbot,* according to Letheby, contain only about 25% of solid matter, of which 18% is nitrogenous. To increase their nutritive value, therefore, these fish should be eaten with butter.

According to the same authority *mackerel, eels,* and *salmon* are richer in fat than the above kinds; mackerel containing about 7%, and salmon about 6%, whilst the matter of eels amounts to nearly 14%. The same is the case with the *sprat,* the *herring,* and the *pilchard,* as well as with most of our fresh-water fish.

As regards *shell-fish,* all the different varieties of them afford about the same amount of nutrition. They contain about 13% of solid matter, which in composition is similar to that of white fish. Shell-fish vary in digestibility; *mussels, limpets,* and *whelks* being rather difficult of digestion, whilst *scallops, cockles, periwinkles, lobsters,* and *crabs* are a trifle more easy of digestion, and *oysters* still more so. All shell-fish are unsuited for delicate stomachs, although they are largely eaten by the poorer dwellers on the coast.

On the Continent, *vineyard snails,* and in China, *slugs,* are eaten and said to possess a delicate flavour and nutritive properties (*Letheby*).

Choice, &c. "The flesh of any fish is always in the highest perfection, or in season, as it is called, during the period of the ripening of the milt and roe. After the fish has deposited the spawn, the flesh becomes soft, and loses a great deal of its peculiar flavour. This is owing to the disappearance of the oil or fat from the flesh, it having been expended in the function of reproduction" (*Fleming's* 'Phil. Zoology'). Fish should be dressed as soon after being caught as possible, as much of their peculiar delicacy and flavour is lost by keeping, even for a few hours. Turbot and salmon are said by the fishmongers to be improved in flavour when 2 or 3 days old, but this is surely a mistake, as the former, when dressed immediately after being caught, possesses a fine creamy taste, which it afterwards loses; whilst the latter, by the loss of a single tide, loses a portion of the fine white curd which is previously found between the flakes, and by longer keeping this curd with the larger flakes disappears altogether. In the eyes of some epicures the richness is, however, increased by this change. Mackerel and some other fish suffer so much from keeping only a few hours, that they become quite unwholesome. Herrings offer a remarkable example of the advantage of dressing fish as fresh as possible. When cooked soon after being caught, they possess considerable delicacy and flavour, but after being kept for only a few hours, the oil separates from the flesh, and they become soft, greasy, and strong-flavoured.

In the choice of every kind of fish, stiffness, brightness of the eyes, and redness of the gills, may be regarded as invariable signs of freshness. A peculiar elasticity will also be perceived in fish recently caught, little or no permanent impression being made by the ordinary pressure of the fingers, from the flesh immediately rising when the pressure is withdrawn. Fresh fish also lie in a partly curled position, and never quite straight, as is the case when they have been kept for some time. Thickness and fleshiness are deemed marks of the good condition of all fish.

Cleaning, Dressing, &c. On the proper cleaning of fish, preparatory to dressing it, depends much of its delicacy and flavour. Ordinary cooks seldom do this well, from not slitting the fish sufficiently open to permit the inside to be thoroughly washed, and seldom using sufficient water. The superior flavour of fish cleaned by the fishmongers arises from their performing the operation more completely, and from the large quantity of water they employ about them. The flavour of all fish is improved by adding a little salt or vinegar to the last water in which they are washed. The sound, milt, and roe should be carefully cleaned and preserved.

Fish is preferably 'dressed' by simple boiling, broiling, or frying; in fact, the finer kinds of fish are often injured by the excessive interference of the cook. When boiled, "all large fish, with the skin whole, must be placed on the fire in cold water; if crimped, or cut into slices or pieces, in boiling water; if whole, it must not be covered with more than two or three inches of water, or

the skin will crack, and not only spoil the appearance of the fish, but will diminish the gelatine and gluten it contains, and instead of eating firm and full of flavour, it will be soft and woolly, especially if over-boiled" (*Soyer*). As soon as a scum rises from boiling, it should be removed by the skimmer. The addition of a little salt or vinegar to the water improves the flavour of most fish, and renders the flesh firmer. The proportions should be "two teaspoonfuls of salt to every quart of water." "If the fish be whole, as soon as it begins to boil remove the cover on one side, and let it simmer gently until done" (*Soyer*). A fish is known to be sufficiently dressed by the flesh in the thicker parts separating easily from the bone. "If a large fish I generally try it by gently pushing a wooden skewer through the thickest part; if it goes in easily it is done" (*Soyer*). When this is the case it should be removed from the kettle, as by soaking in the water fish loses its firmness and becomes soddened. Sole, skate, and mackerel are usually put into boiling water, whether whole or sliced. Fish for broiling should be well washed in strong vinegar, wiped dry with a towel, and floured before placing them on the gridiron; and the bars of the latter should be hot and well buttered (*Rundell*). Fish for frying should be prepared as for broiling, and the butter, oil, or lard should be allowed to boil for a minute or two before putting them into the frying-pan. The latter should be perfectly smooth and bright, and the butter or oil in abundance, to prevent the fish sticking to it and burning. As the fish are cooked solely by the heat of the melted fat, to fry them in the highest perfection there should be enough of it to cover them. Butter or oil is the best for the purpose. To avoid loss, the contents of the frying-pan, after the fish is removed, should be poured into a clean jelly-jar or basin, and reserved for another occasion. The fish being removed from the pan, the superfluous fat should be drained from them preparatory to 'serving' them. When fish is divided into fillets or cutlets before being cooked, it is usual to take out the bones, and to dress it with forcemeat, &c.

In serving fish of the finer kinds, no other additions are required than melted butter and the ordinary fish sauces and pickles. The dishes are commonly garnished with raw parsley, for the sake of appearance, but boiled parsley, chopped small, should accompany it. All kinds of fish should be served on a napkin.

FISH GLUE. See GLUE and ISINGLASS.

FISH POISONING. See ACCIDENTS.

FISH SKIN. *Syn.* SHARK SKIN. The skin of the spotted dog-fish or rough hound (*chien de mer*, Fr.), stretched and dried. Used for polishing wood and ivory. Several other varieties of fish skin are employed in the *arts*. The dressed skin of the 'rousette' (*peau de rousette*, Fr.) is transparent, and very beautiful. Cemented on green paper, and rubbed down and polished, it is used as veneer for fancy boxes. The skins of several varieties of Squalus are also used for both the above purposes. See SHAGREEN.

FIVE HERBS. See SPECIES.

FIX'ATURE. *Syn.* BANDOLINE, CLYSPHITIQUE, EAU COLLANTE, FIXATEUR, Fr. This consists of any of the simple vegetable mucilages, combined with a little spirit to preserve it, and with a little perfume to render it more agreeable.

Prep. 1. From carrageen, Irish, or pearl moss, soaked in cold water for an hour or two, and after being drained, and pressed dry in a clean napkin, dissolved by boiling in soft water, q. s. The decoction is strained through cambric, and when nearly cold is mixed with about 1-3rd or 1-4th of its volume of eau de Cologne or other scented spirit, with the further addition of a few drops (5 or 6) of oil of cloves. Sometimes a little brandy is added to the mucilage, and when it is intended for present use, as is common with home manufactures, the spirit is frequently omitted altogether. $\frac{1}{4}$ oz. of the prepared moss is fully enough for $\frac{3}{4}$ pint of strained decoction, if rightly managed.

2. From quince seed boiled in water, as the last. $\frac{1}{4}$ oz. yields nearly $\frac{3}{4}$ pint of strained decoction.

3. Pale gum-arabic (picked), $1\frac{1}{2}$ oz.; rose-water, 2 fl. oz.; pure water, 3 fl. oz.; dissolve.

4. Gum-arabic, $3\frac{1}{4}$ oz.; water, $\frac{1}{2}$ pint; dissolve, and drop in eau de Cologne, gradually, until the cloudiness at first occasioned ceases to be removed by agitation; the next day decant the clear portion. All of the above are very superior, and keep well.

5. (*Redwood.*) Gum-tragacanth, $1\frac{1}{2}$ dr.; water, 7 oz.; proof spirit, 3 oz.; otto of roses, 10 drops; macerate 24 hours, and strain.

6. Malt, 7 oz.; hot water (that will barely permit the finger to be held in it without pain), $\frac{1}{2}$ pint; infuse in a covered jug or basin, gently press out the liquid, and as soon as cold add of proof spirit (or brandy or Cologne water), $2\frac{1}{2}$ fl. oz., and strain.

Obs. Bandoline is used by ladies and by hair-dressers for stiffening the hair, and to make it curl firmly and remain in place. It is applied either by moistening the fingers and passing the hair through them, or by means of a small sponge. See POMMADE.

FIXED AIR. See CARBONIC ACID.

FIXED OILS. See FAT and OILS.

FLAKE WHITE. See WHITE PIGMENTS.

FLAME. Gas or vapour in an incandescent state. The light emitted from pure flame is exceedingly feeble; illuminating power being almost entirely dependent upon the presence of incandescent solid matter, usually carbon in the flame. It was once stated that a pure gas gave when burnt an absolutely non-luminous flame, but it has since been shown that when gases burn under considerable pressure a certain amount of light is emitted. See ILLUMINATION, and *below*.

Flame Colours. The vapours of metallic compounds communicate colours to flames. The characteristic colours afforded by some metals are very beautiful, and their exhibition forms a favourite experiment of chemical lecturers. The coloured flames are generally produced by the combustion of alcohol or rectified spirit containing certain salts in fine powder. In this way a GREEN colour is communicated by boracic acid or

chloride of copper; a RED one by the nitrates of iron, lime, and strontia; a VIOLET by potassa and its salts; and a YELLOW by nitrate of soda. Messrs Church and Crookes have described a mode of exhibiting the characteristic flames of the metals which is admirably adapted for the lecture-table. 'Gun-paper,' made in the same way as 'gun-cotton,' is to be soaked in solutions of the chlorates of the different metals, dried with care, and kept dry. A good 'gun-paper' for the purpose is prepared by soaking strips of Swedish filtering-paper for ten minutes in a mixture of 4 parts oil of vitriol with 5 parts strong nitric acid, both by measure. The strips, when taken out of the acid, should be washed first with cold, and then with hot rain or distilled water, till the washings are no longer sour to the taste. The solutions of the metallic salts need not be very strong; but if they are warm, the strips of 'gun-paper' will be more easily and completely saturated with them. Since some of the chlorates attract moisture from the air, it is better to dry the papers prepared with them before the fire previous to lighting them. They are shown to best advantage when a strip is loosely crumpled up into a pellet, lighted quickly at one corner, and thrown up into the air against a dark background. They leave after burning, if properly prepared, no ash whatever. Paper prepared with the salt of potassa gives a flash of VIOLET flame, that prepared with the soda salt the characteristic YELLOW flame, and that with chlorate of baryta a very beautiful GREEN light. The chlorates of strontium, lithium, and calcium, when thus ignited, give intense colours. The VIOLET-BLUE flame of copper is well seen even with the chloride of that metal, while paper soaked in nitrate of potassa shows the potassium flame better than if the chlorate be used. 'Gun-paper' prepared with a very weak solution of chloride or chlorate of thallium shows the characteristic SPRIG-GREEN flame of that metal with great distinctness. Chlorate of barium, being an article of commerce, may be employed for the preparation of the other chlorates, it being merely necessary to add to this salt in solution an exactly equivalent quantity of the sulphate or carbonate of the metal whose chlorate is desired. For instance, in order to make 'chlorate of copper,' 15·1 gr. of chlorate of barium being dissolved in hot distilled water, a boiling solution containing 12·5 gr. of pure crystallised sulphate of copper is to be added to it. Insoluble white 'sulphate of baryta' falls, while the solution, filtered and evaporated, yields the new chlorate in crystals. See FIRES, PYROTECHNY, &c.

FLAN'NEL. See CLOTHING.

FLASH. *Prep.* From burnt-sugar colouring, 1 gall.; fluid extract of capsicum or essence of cayenne, $\frac{3}{4}$ pint, or enough to give a strong fiery taste. Used to colour spirits, and to give them a false strength. It is made by the brewers' druggists, and labelled 'ISINGLASS AND BURNT SUGAR.'

FLASKS. These instruments, which are largely used by chemists in the *laboratory*, are made of glass, and consist of a bulb blown on the end of a tube; usually the bottom of the bulb is flattened, and the open end of the tube is turned over so as to form a rim or flange. For special purposes flasks are made conical in shape, with flat bottoms and short necks.

If flasks are to be used for boiling liquids it is advisable that they should be made of the best Bohemian hard glass; these are unfortunately somewhat difficult to procure in England, as those sold by the dealers in chemical apparatus as made of Bohemian glass are usually of inferior quality.

Amateur chemists are often recommended to use Florence oil-flasks as a cheap substitute for flasks specially made for chemical purposes; it is, however, much better to buy the latter, for the oil-flasks are very liable to crack when heated, being made of such thick glass, and they are not always so easily procurable as one is led to suppose.

FLAT'ULENCE. *Syn.* FLATULENCY, WIND. In *pathology*, a morbid collection of gas in the stomach and bowels. Its most common cause is indigestion. The avoidance of indigestible food, especially peas, beans, &c., and the adoption of a simple diet with plenty of fresh air and exercise is the best means of preventing flatulency.

To relieve flatulency, carminatives and aromatics, as black pepper, mustard, peppermint, ginger, cinnamon, lavender, and most spices, may be had recourse to. A glass of peppermint cordial, or of brandy strongly flavoured with peppermint or ginger, is a popular and efficient remedy. A few drops (15 to 30) of ether, with a little tincture of capsicum or spirit of sal-volatile, seldom fail to give relief. See DYSPEPSIA.

FLAVOURING SUBSTANCES. See ESSENCE, OIL (Volatile), SPICE, WINE, &c.

FLAX. See LINEN, LINSEED, and OIL.

FLEA. This troublesome little animal is the *Pulex irritans* of Linnæus, and belongs to the *Suctoria*, or fourth order of the *Insecta*. Its favourite haunts are our warm underclothing, and its most productive breeding-places are in the 'flue' which careless servants allow to accumulate underneath our beds. Cold, light, cleanliness, and ventilation, are inimical to its propagation.

FLECHTENKAPSELN—Tetter Capsules, or Dr Berkeley's Antiherpetic Capsules for Skin Diseases, Tetter, &c. Capsules filled with tar (*Hager*).

FLECHTENMITTEL—Tetter Cure. (*Paris.*) 1. A washing fluid. Common water, containing $1\frac{1}{2}\%$ sulphuric acid. 2. A salve. A mixture of lard and spermaceti, with 1-24th of their weight of calomel (*X. Schmidt*).

FLECHTENPULVER — Tetter Powder. (St Lube's, France.) Nitre, 100; antimony chloride, 10; antimony oxide, 200.—*Dose*, 1·5 gr. (*Wittstein*).

FLECHTENSALBE—Tetter Salve. (*Fontaine*, Paris.) For all skin diseases. Olive oil and white wax, with 1-16th of white precipitate (*Wittstein*).

Flechtensalbe. (*Bruno Reichel*, Apolda.) A mixture of wax and lard, coloured green (*Schädler*).

Flechtensalbe. (*F. Schwarzlose*, Berlin, and *S. G. Schwartz*, Breslau.) For salt-flux, tetters, and similar skin diseases. Peru balsam, 1; carbolic acid, 2; yellow wax, 10; lard, 30 (*Schädler*).

Flechtensalbe. (*Surbi*, Paris.) For all kinds of skin diseases. A mixture of beef tallow, 30; olive oil, 10; zinc oxide, 2; steatite, 2 (*Wittstein*).

FLECKENWASSER. (*Bronner.*) Cleansing fluid (literally spot or stain water) for the removal of grease and dirt spots. Benzine only.

Fleckenwasser, Englisches. English cleansing fluid for removing acid, resin, wax, tar, and grease spots. A mixture of 95% alcohol, 100 grms.; liq. ammon., sp. gr. ·875, 30 grms.; benzine, 4 grms. (*Artus*).

FLEISCH-EXTRACT-LIQUEUR—Eau de Vie Alimenteuse—Extract of Meat Liqueur—Aqua Vitæ Incarnativa. (*A. Hensel*, Berlin.) A beautiful red spicy liquor, leaving, when distilled, 32% of solid matter. This residue contains in 100 parts (besides anilin-red), resin and extractive (partly from ginger and partly from cinnamon), $3\frac{1}{4}$; sugar, $27\frac{1}{2}$; extract of meat, $1\frac{1}{4}$ (*Hager*).

Fleisch-Extract-Syrup—Syrup of Extract of Meat. (*Meyer*, Berk.) Blood-serum made into a syrup with sugar (*Hager*).

FLESH. *Syn.* Caro, L. The muscular substances of animals; the softer solid portions of the body, as distinguished from the bones and fluids. See Fibrin, Food, &c.

Flesh-brush. An instrument used for exciting the cutaneous circulation. A good rough towel vigorously used will answer every purpose of the flesh-brush.

FLIEGENPAPIER, GIFTFREIES—Non-Poisonous Fly Papers. (*Bergmann & Co.*, Rochlitz.) Contains abundance of arsenious acid (*Hager*).

FLIEGENPULVER—Fly Powder. (*Baumann*, now *Markel*, Austria.) 93% to 94% of dry sandy ferruginous clay (ordinary loam) saturated with a decoction of some bitter substance, as quassia or gentian (*Hager*).

FLIES. See Fly.

FLIP. See Egg-flip.

FLOHEMITTEL—Flea Powder. (Leipsic.) Powdered soap (*Fischer*).

FLOHEWASSER—Flea Water. (*Koch*, veterinary surgeon, Vienna.) 7 brandy, 1 benzine, 1 black soap (*Hager*).

FLONG, for Stereos. Make a paste of 1 lb. of flour, $\frac{1}{2}$ lb. of whiting, 2 oz. of melted glue, and a very little alum. Mix with water so as to make a paste of the consistence of cream, and pass it through a strainer. Take a sheet of blotting-paper and paste it thinly and evenly all over; cover this with a sheet of tissue-paper, taking care to rub it all over with the hand in such a way as to prevent its creasing. Then add two more sheets of tissue pasted in the same way. Turn the flong over and paste a sheet of wrapper or sugar-paper on the blotting. Then roll it flat with an iron roller or a wooden ruler, and let it stand for a few minutes, when it will be ready for use.

FLORILINE—Vegetable Tooth Paste made by John Yates. (*Albin Müller*, Brünn.) It is contained in a quadrangular china pot, and is a red, dry, rather hard mass, made from prepared chalk, 20 grms.; starch-powder, 10 grms.; glycerin, 8 grms.; pellitory tincture, 3 grms.; peppermint oil, 10 drops; and water, q. s., coloured with Florentine lac (*Hager*).

FLOUN'DER. A flat fish, very like the plaice, but smaller, and of more obscure colour. It is very common about the British coast, and is found in the Northern, Baltic, and Mediterranean Seas. Its flesh is very wholesome.

FLOUR. *Syn.* Farina, L. The finely ground and 'dressed' meal of bread corn, and of the seeds of some of the Leguminosæ. That known specifically as 'flour' in this country is obtained from spring varieties of *Triticum vulgare* (the common wheat).

Var., *&c.* Of varieties of flour there are several, depending chiefly on the amount of bran which they contain, and the relative fineness of the sieves through which they are passed:

Fine Wheat-flour, Pastry Flour; Farina, F. tritici, F. seminis tritici. The finest flour, obtained from the meal produced in the first grinding of wheat between sharp stones, by means of a sieve of 64 wires to the inch. Used for pastry.

Middlings. The remainder of the flour of the first grinding, obtained by means of a slightly coarser sieve. Used for making household bread, but is mostly reground for the next variety.

Seconds. The finest part of the flour, obtained by regrinding 'middlings' between blunt stones. Used by the bakers for their finest wheaten bread.

Pollard. The coarse flour from which the seconds has been sifted. Used for making sea biscuits and gingerbread, and to fatten poultry and hogs.

Country Household Flour. This is usually ground only once, and sifted to 4-5ths of the weight of the wheat.

Ammunition Flour is ground and sifted to nearly 5-6ths the weight of the wheat.

According to Mr Accum, thirty-two pecks of wheat in the London mills yield, of flour, $38\frac{1}{2}$ parts; pollard, 8 parts; and bran (*Furfur tritici*), 12 parts; the bulk of the wheat being doubled by grinding.

According to Mr Hard, miller, of Dartford, quoted by Dr Pereira, the wheat having been ground in the usual way, is allowed to remain in the state of meal for some time before 'dressing,' which removes the heat caused by the process, and enables the miller to obtain more flour, and the baker a better quality, than if 'dressed' immediately it is ground.

"The process of dressing is by a wire cylinder containing a certain number of sheets of different texture or fineness, which cylinder contains eight hair-brushes attached to a spindle passing through the centre of the cylinder, and laid out so as to gently touch the wire. This cylinder is fed by a 'shoe' with the meal; then the 'flour' and 'offal,' after passing through the wire in this way, are divided by wooden partitions fixed close to the outside of the cylinder." "The produce of the wheat-meal dressed through the wire machine consists of—1, flour; 2, white stuff, or boxings, or sharps; 3, fine pollard; 4, coarse pollard, or horse pollard; 5, bran. The second product (*i. e.* the white stuff) is then submitted to another 'dressing' through a fine cloth machine, and produces—1, fine middlings, for biscuits; 2, toppings, or specks; 3, dustings; 4, best pollard, Turkey middlings, or coarse middlings."

TABLE *of the Produce of One Quarter of Wheat* (= 504 lbs.). By Mr HARD.

Flour	392 lbs.
Biscuit or fine middlings	10 „
Toppings or specks	8 „
Best pollard, Turkey p., or twenty-penny	15 „
Fine pollard	18 „
Bran and coarse pollard	50 „
Loss by evaporation and waste	11 „
	504 „

According to Vauquelin, French wheat-flour contains about 10% of water, 11% of gluten, 71% of starch, 5% of sugar, and 3% of gum; and the water of the dough amounts to about 50%. The quantity of the bran in wheat ranges under 2%.

Pur. This article of food is very frequently adulterated both by the miller and the baker, as has been before alluded to in the article on bread. The principal physical characteristics of wheat-flour of good quality are the following: it has a dull white colour, somewhat inclining to yellow; it exhibits no trace of bran, even when pressed smooth with the hand, or with a polished surface; its cohesiveness is so great that, on being squeezed in the hand, the lump is some time before it loses its shape; it has a homogeneous appearance, and does not lose more than from 6% to 12% by being carefully dried in a stove. The smaller the loss in this way the finer is the quality, other matters being equal, and the more economical in use (see *below*).

Analysis of Flour.

	PELIGOT. Mean of 14 Analyses.	LETHEBY.	PAYEN.	WANKLYN. Fine Wheaten Flour.
	Per cent.	Per cent.	Per cent.	Per cent.
Water	14·0	15·0	14·22	16·5
Fat	1·2	2·0	1·25	1·2
Nitrogenous matter, gluten, &c.	12·8	10·8	14·45	12·0
Ditto, soluble in water	1·8	...	...	...
Non-nitrogenised substances, dextrin, sugar, &c.	7·2			
Starch	59·7	70·5	68·48	69·6
Cellulose	1·7			
Salts (ash)	1·6	1·7	1·6	0·74

Tests. 1. Solution of ammonia turns pure wheat-flour yellow; but if any other corn has been ground with it, pale brown; or if peas or beans have been ground with it, a still darker brown.

2. Solution of potassa, containing about 12% of caustic alkali, dissolves pure wheat-flour almost completely; but when it is adulterated with the flour of the leguminous seeds (beans, peas, &c.), the cellulose of these substances remains undissolved, and its hexagonal tissue is readily identified under the microscope. Mineral substances (chalk, plaster of Paris, bone-dust, &c.) are also insoluble in this test, and appear as a heavy white sediment.

3. Boiling water poured on the sample causes the evolution of the peculiar odour of pea or bean-flour when these substances are present. Bread made with such flour evolves a like odour on being toasted.

4. Pure hydrochloric acid poured on potato-flour, or on wheat-flour adulterated with it, develops a smell of rushes; it also dissolves starch, but changes the colour of pure wheat-flour to a deep violet.

5. Nitric acid turns wheat-flour of an orange-yellow colour, but forms a stiff and tenacious jelly with potato fecula, the colour of which it does not alter.

6. A portion of the suspected sample submitted to dry distillation in a stoneware retort, and the distillate collected in a receiver containing a little water, the latter is found to remain perfectly neutral if the wheat-flour is pure, but acquires a distinctly alkaline reaction when beans, pulse, or pea-meal is present (*Rodrigues*).

7. Triturate 300 gr. of the sample with an equal weight of clean siliceous sand, and after 5 minutes form a homogeneous paste with water; afterwards further adding more water, until about 2 fl. oz. have been used. The filtered liquid, treated with an equal quantity of a strong and pure aqueous solution of iodine, develops a pink colour, which gradually disappears when the specimen examined consists of pure wheat-flour; but assumes a deep-purple colour, which disappears much more slowly if the flour is adulterated with even 10% of fecula or potato-flour. This test succeeds, not only with flour and meal, but also with macaroni, vermicelli, &c. (*M. Chevallier*).

8. The milky liquid holding the starch in suspension is poured into a small conical glass and left at rest for some time; the clear liquid is then decanted, and any remaining water carefully sucked up with a pipette and the whole left for a while, in order that the deposit may harden. The upper grey layer is next removed with a tea-spoon, and the harder and stiffer second layer left undisturbed until it becomes quite solid by drying. When in this state it may be upset in the form of a cone upon a lump of dry plaster. The fecula or potato-starch (if any is present), being heavier than that of wheat, forms the apex of the cone, and its quantity may be estimated in the following manner:—The operator cuts from the apex of the little cone above mentioned a slice, which he triturates only for a short time in an agate

mortar (one of glass, or porcelain, or wedgwood-ware will not do), and he tests that with aqueous solution of iodine. If it turns blue, it is fecula. Another slice is treated in the same manner until the operator comes to the wheat-starch, which, in the present instance, is not affected by the aqueous solution of iodine. This difference of behaviour of the two species of starch with iodine is due to the friction of the pestle and mortar, which is sufficient to divide or tear the envelopes of the particles of the potato-starch, which then become blue when treated by solution of iodine. The particles of wheat-starch, on the contrary, are not disaggregated by that treatment, and being therefore protected by their envelope, are not acted upon by the solution of iodine, or, at most, assume only a brown tinge (*M. Robine*).

9. Wheat-flour adulterated with plaster of Paris, ground bones, chalk, and potato-flour has a higher sp. gr. than a sample of the pure flour. This may be readily ascertained by any person by filling a small vessel with some pure flour, and then with the given sample. "A vessel which will contain 1 lb. of wheat-flour will contain $1\frac{1}{2}$ lb. of fecula" (potato-flour), and hence "the proportion of this adulteration may be easily estimated" (*Ure*).

10. If to a sample of wheat-flour is added a solution of potassa, containing about $1\frac{3}{4}\%$ of the pure alkali, the granules of potato farina, or of bean-meal, or pea-meal present (if any), will acquire 4 or 5 times their original volume, while those of the pure wheat-starch will be scarcely affected by it. This change is very perceptible under a microscope of small power. 2 parts of liquor of potassa (Ph. L.) and 5 parts of distilled water form a mixture that answers for the above purpose.

11. By means of the microscope the admixture of the cheaper feculas and meals with wheat-flour is readily detected by the characteristic appearance of the starch-grains; and when the adulteration exceeds 9% or 10%, its extent may be readily estimated with considerable accuracy. As the range of adulteration is generally from 12% to 27%, this method is applicable in the greater number of cases.

Analysis. The value of wheat-flour as an aliment depends upon the quantity of gluten, sugar, starch, and phosphate of lime which it contains; and its superiority over the flour of the grains of the other cereals is referred to its containing a larger proportion of the first and last of these substances than they do. The quantitative analysis of flour is very simple, and may be easily made by persons unacquainted with chemistry by attending to the instructions below:

a. Make 1000 gr. of the sample into a dough with a little water, let it rest an hour and then gently knead it in successive water, until the starchy particles are perfectly removed. Collect the portion (GLUTEN) left in the hand, drain off the water, place it on a piece of filtering or blotting paper, several times doubled, and set it aside.

b. Mix the several waters employed in the preceding process, and set them aside in a tall vessel, to deposit the suspended portion (STARCH). After a sufficient time pour off the clear liquid, and throw the whole of the sediment on a weighed paper filter, placed in a funnel, observing to remove the portion adhering to the bottom of the vessel by means of a little clean water, that none may be lost.

c. Evaporate the decanted liquid, as well as what runs from the filter, until it becomes curdy, then filter it through a piece of weighed blotting-paper, and preserve the sediment (ALBUMEN); next evaporate the residuum to the consistence of a syrup, agitate it with 10 times its weight of alcohol, and filter, observing to wash the paper filter clean with a little alcohol after the solution has passed through it. The substance on the paper is PHOSPHATE OF LIME and GUM, and must be set aside. By subsequent digestion in water, filtration, and evaporation, the two may be obtained separately.

d. Evaporate or distil off the spirit from the solution and washings, as above; the residuum is SUGAR.

e. Dry the substances obtained as above by a gentle heat, and weigh them. The weight of the albumen may be taken with that of the gluten, as it possesses about the same nutritive value, and also because it has been asserted by some persons that the former substance is in reality gluten, and not albumen. By dividing the given weights by 10, the percentage value of the sample is obtained. The pieces of filtering paper employed should be carefully dried and weighed before using them, and the same degree of heat should be employed for this purpose as that to which they will be afterwards exposed in the drying of the substances resulting from the operations.

Obs. The above method of ascertaining the actual value of any sample of flour as an article of food, though not strictly accurate, approximates sufficiently to the truth for all practical purposes, and is well adapted to the wants of the baker and large purchaser. In many cases it will only be necessary to perform the first part of the process (*a*), which will give the percentage of the most important constituent of the flour; the rest being of minor consequence.

In addition to what has been already stated in the article on BREAD, it may be useful to mention that a pound of the best flour, from thoroughly dried wheat, will take 10 fl. oz. of water to form it into ordinary dough, or 9 fl. oz. to form it into bread dough. Under the old parliamentary Acts a sack of flour (280 lbs.) was presumed to produce 80 loaves (quartern or quarter-peck), the weight of which, within 48 hours after being baked, was to be 4 lbs. $5\frac{1}{2}$ oz. each. At the present time fully 92 loaves, weighing 4 lbs. each, are produced by the London bakers from one sack of flour, when honest weight is given; but as the latter is rarely the case, and the bread is frequently 'slack' or 'under-baked,' and thus contains more water than good bread ought to do, a much larger product is commonly obtained. The dough loses about 1-7th of its weight in baking, if in batches; but fully 1-6th if baked in small loaves and placed in the oven separately. The best bread contains about 11-46ths of its weight of added water; and common bread often much more than 1-4th. The proportion of water in the London

bread has greatly increased during the last few years, owing to the introduction of the fraudulent plan of making the dough with rice jelly or moss jelly. This is the reason why the bread of some bakers suffers such a loss of weight in a few hours after being taken from the oven. A 4-lb. loaf of bread purchased from a baker at Lambeth, after remaining on the sideboard of a sitting-room for 24 hours, was found to have lost no less than 6½ oz. by evaporation, and in two days longer its interior cells were covered with green mould, and the whole was unfit for food. The bakers, aware of these facts, are particularly careful not to bake more bread than they can dispose of whilst 'new,' and are in the habit of refusing to weigh their bread before selling it, when it is more than 10 or 12 hours old, although they are liable to be 'fined' for such a refusal. See BREAD, CAKES, FARINA, &c., also *below*.

Flour, Baked. *Syn.* FARINA TOSTA, F. TRITICI TOSTA, L. *Prep.* From wheat-flour, carefully baked in a 'slack' oven, until it acquires a pale-buff hue. Astringent; used to make food for infants troubled with diarrhœa. See FARINA.

Flour, Barley (Prepared). *Syn.* FARINA HORDEI PREPARATA, L. *Prep.* (Ph. Bor.) From barley-flour, compressed into a tin cylinder until the vessel is 2-3rds full, which is then suspended at the upper part of a still 2-3rds filled with water, and after the 'head' is fitted on, the water is kept boiling for 30 hours (2 days of 15 hours each). Lastly, the upper layer being removed, the rest is reduced to powder, and kept in a dry place.

Flour, Boiled. *Syn.* TRITICINA, FARINA PRÆPARATA, L. *Prep.* From fine flour, tied up in a linen cloth as tight as possible, and after it has been frequently dipped into cold water, the outside of the cloth is dredged over with flour until a crust is formed round it, to prevent the water soaking into it whilst boiling; it is then boiled for a long time, and when cold, it is divided into small oblong pieces. For use it is reduced to powder, either by grinding or grating it, and is then prepared like arrowroot. It forms a good diet for children, in diarrhœa, &c.; and as it may be easily prepared at home, it has the advantage of being free from adulteration.

Flour, Jones's Patent. *Prep.* From kiln-dried flour, 1 cwt.; tartaric acid, 10½ oz.; mix thoroughly; after 2 or 3 days add, of bicarbonate of soda, 12 oz.; lump sugar, ½ lb.; common salt, 1½ lbs.; mix, and pass the compound through the 'dressing-machine.' It is necessary that the whole of the ingredients should be perfectly dry, and separately reduced to fine powder before adding them to the flour. By simply mixing it with cold water and at once baking it, it produces light, porous bread.

Obs. We have already had occasion to pay a passing tribute to the excellence and usefulness of Jones's patent flour. It is, indeed, invaluable to every household as furnishing the means of producing, with great economy and extemporaneously, not merely cakes, puddings, pastry, and fancy bread, but the 'staff of life' itself, household bread of a purity, flavour, and lightness seldom, if ever, met with in that purchased of the bakers.

Flour, Sewell's Patent. *a.* (No. 1.) Flour, 1 sack (280 lbs.); hydrochloric acid (sp. gr. 1·14), 45 oz.; mix, by adding the acid in a 'spray.' *b.* (No. 2.) To the last, add (expertly) bicarbonate of soda, 39 oz.; mix thoroughly, and pass the whole through a sieve or 'dressing-machine.'

Obs. This flour is used as the last, to which, however, it is inferior in quality. No. 1 will keep 5 weeks. No. 2 will keep a month. Jones's flour will keep good in a dry place for years. If No. 1 is alone employed for the dough, to each pound of the flour, 65 gr. of bicarbonate of soda, with salt q. s. must be added. The patentee claims for his invention the merit of the soda and acid being converted into culinary salt in the process of making up the flour and baking the dough.

FLOWERS, Cut (to keep fresh). Flowers may be preserved in a fresh state for a considerable time by keeping them in a moist atmosphere. When growing on the parent stem, the large amount of evaporation from the surface of their leaves is compensated for by an equivalent proportion of moisture supplied by the roots; but when they are plucked, the evaporation from the surface continues, while the supply of moisture is cut off. To supply, in part, this loss of moisture by evaporation has arisen the almost universal practice of placing flowers in water; but their mutilated stems possess a far inferior power of sucking up fluids to that of the roots, and thus their decay is only deferred for a time. To preserve them more effectually, or at least to render their existence less ephemeral we may surround them with a moist atmosphere, by which the loss of water from the surface of their leaves will be reduced to the smallest possible amount.

Another method by which some flowers may be preserved for many months is to carefully dip them, as soon as gathered, in perfectly limpid gum water, and after allowing them to drain for 2 or 3 minutes, to set them upright, or arrange them in the usual manner in an empty vase. The gum gradually forms a transparent coating on the surface of the petals and stems, and preserves their figure and colour long after they have become dry and crisp.

Yet another method (given in the 'Pharmaceutical Journal') is as follows:—"A vessel with a moveable cover is provided, and having removed the cover from it, a piece of metallic gauze of moderate fineness is fixed over it, and the cover replaced. A quantity of sand is then taken sufficient to fill the vessel, and passed through a sieve into an iron pot, where it is heated with the addition of a small quantity of stearin, carefully stirred so as to thoroughly mix the ingredients.

"The quantity of stearin to be added is at the rate of ½ a part to 100 parts of sand. Care must be taken not to add too much, as it would sink to the bottom and injure the flowers. The vessel with its cover on and the gauze beneath it is then turned upside down, and the bottom being removed, the flowers to be operated upon are carefully placed on the gauze and the sand gently poured in, so as to cover the flowers entirely, the leaves being thus prevented from touching each other. The vessel is then put in a hot place, such, for instance, as the top of a baker's oven, where it is left for 48 hours. The flowers thus become

dried, and they retain their natural colours. The vessel still remaining bottom upwards, the lid is taken off, and the sand runs away through the gauze, leaving the flowers uninjured."

Faded flowers may be generally more or less restored by immersing them halfway up their stems in very hot water, and allowing them to remain in it until it cools or they have recovered. The coddled portion of the stems must then be cut off, and the flowers placed in clean cold water. In this way a great number of faded flowers may be restored, but there are some of the more fugacious kinds on which it proves useless.

Flowers. *Syn.* Flores, L. Among chemists, this term is applied to various pulverulent substances obtained by sublimation, as flowers of antimony, benzoin, zinc, sulphur, &c. The term has been discarded from modern chemical nomenclature, but is still commonly employed in familiar language and trade.

FLUID CAM'PHOR. *Prep.* (*Sir J. Murray.*) From camphor (in powder), 1 dr.; freshly precipitated carbonate of magnesia, 2 dr.; cold distilled water, 1 pint; the solution is effected by forcing in carbonic acid gas under pressure. Each fl. oz. contains 3 gr. of camphor and 6 gr. of carbonate of magnesia. See Essence of Camphor.

FLUID MAGNESIA. *Syn.* Liquor Magnesiæ carbonatis, L. m. bicarbonatis, L. The preparations sold under this name are mere solutions of freshly precipitated carbonate of magnesia in water, formed by means of carbonic acid gas under powerful pressure and long agitation. The best known are Sir J. Murray's and Mr Dinneford's, each fl. oz. of which is said to contain about 17½ gr. of the carbonate, but their actual richness in the latter seldom exceeds 10 or 12 gr., and by the time they reach the consumer is often as low as 5 or 6 gr. Recently precipitated carbonate of magnesia, placed in a bottle or other suitable vessel, which is then filled by means of a soda-water apparatus with water fully charged with carbonic acid gas, readily dissolves on slight and cautious agitation, and the aërated water becomes saturated with magnesia. A scruple of carbonate of magnesia put into a soda-water bottle and thus treated is all taken up in from 20 minutes to half an hour, and the beverage continues beautifully clear.

FLUKE. *Syn.* Fasciola; Distome, Fr.; Leberwurm, Ger. A genus of trematode parasites infesting men and the higher vertebrate animals. The egg is about the 1-280th of an inch long and 1-270th inch wide.

The embryo is frequently met with in sewage water, from which, if it be removed and placed in pure or distilled water, it soon dies. The embryo which does not become a distoma gives rise to a progeny (gradually formed from germ-cells within it) consisting sometimes of one, but much more often of a number of bodies of various forms and structures, each of which possesses powers of movement and locomotion. But the creatures of this second development are not distomata; neither are the offspring to which they in their turn give rise. Like their immediate progenitors, this offspring produce in their interior germ-cells, which develop into minute worms having tails, and displaying great vivacity when placed in water. These latter alone exhibit the characters of true distomata. "These cercaria now either become enclosed, like a chrysalis in a pupa state. or they penetrate into the bodies of soft animals, become encysted and parasitic. It appears probable that the distomata enter the human intestinal canal as cercaria, and then pass into the biliary passages" (*Blyth*).

A case is on record of two distomata having been extracted from the foot of a woman, into which it has been surmised they gained an entrance as cercaria whilst the woman was bathing.

It is thought that shell-fish, as well as uncooked fish, when eaten, may be the means of introducing these parasites into the human system. The embryos of the *Distomata hepaticum* swim about and live in water, which may probably, when drunk, be the means of conveying them into the bodies of men and sheep. The ailments and symptoms to which these pests give rise depend upon the particular organ or portion of the body in which they establish themselves.

In man they are a frequent cause of hæmaturia and dysentery. In sheep they occasion fearful mortality, giving rise to the disease known as 'the rot,' and killing thousands annually. "The number of species affecting men are usually enumerated as nine, viz. *Fasciola hepatica, Distoma crassum, D. lanceolatum, D. ophthalmobium, D. heterophyes, Bilharzia hæmatobia, Tetrastoma renale, Hexathrydium renarum,* and *H. pinguicola.*"

FLUM'MERY. A species of thick hasty-pudding made with oatmeal or rice, flavoured with milk, cream, almonds, orange flowers, lemons, &c., according to fancy.

Prep. 1. (Dutch Flummery.) From blancmange and eggs, flavoured with lemon-peel and sweetened with sugar.

2. (French Flummery.) From equal parts of blancmange and cream, sweetened, and flavoured. The above are poured into forms and served cold, to eat with wine, spirit, cider, &c.

3. (*A. T. Thomson.*) Take oatmeal or groats, 1 quart; rub it for a considerable time with hot water, 2 quarts, and let the mixture stand until it becomes sour; then add another quart of hot water, and strain through a hair-sieve. Let stand till a white sediment is deposited, decant the fluid portion, and wash the sediment with cold water. This is now to be boiled with fresh water until it forms a mucilage, stirring the whole time. A light and nutritious food during early convalescence.

FLUOBORIC ACID. *Syn.* Borofluoric acid. This may be easily prepared by saturating hydrofluoric acid with boracic acid, keeping the mixture cool, and then concentrating it in platinum vessels till dense fumes arise.

FLUOHYDRIC ACID. See Hydrofluoric Acid.

FLUORIDE OF HYDROGEN. See Hydrofluoric Acid.

FLU'ORIDES. Compounds of fluorine with metals and other basic radicals. The fluorides of the metals are, with the exception of those of the alkaline metals, insoluble in water, while the

fluorides of hydrogen, boron, and silicon are gaseous, condensing at a low temperature to volatile liquids, and in the case of the last two, decomposed by water. For the naturally occurring fluorides (see FLUORINE, *below*).

FLUORINE. F. Atomic weight = 19. A non-metallic, or negative element belonging to the same group as chlorine, bromine, and iodine, which elements it strongly resembles in its chemical properties.

Source. It occurs in nature as FLUOR-SPAR (calcium fluoride, CaF_2), found in Derbyshire (where it is known as BLUE JOHN) and elsewhere, and as CRYOLITE (double fluoride of sodium and aluminium, $3NaF.AlF_3$), found in Greenland. Fluor-spar is used as a flux, and cryolite for the manufacture of pure alumina and soda.

Prep. Owing to the great energy with which it attacks and combines with most substances it was long unknown in the free state, but it has lately been isolated by M. Moissan, a French chemist. He obtained it by electrolysing a solution of anhydrous hydrofluoric acid, containing some potassium fluoride, in a platinum U-tube which was cooled considerably below the freezing point. Electrodes made of an alloy of platinum containing 10% of iridium were used.

Prop. Fluorine is a colourless gas possessed of extraordinary chemical energy. It is the most negative element known, and combines at the ordinary temperature with nearly all elements, the combination being very often so vigorous as to give rise to the production of flame. It displaces the negative elements, even oxygen, from their compounds; for example, chlorides, bromides, and iodides are at once decomposed, fluorides being formed, and the chlorine, &c., set free; while with water it forms hydrofluoric acid, and liberates the oxygen in the form of ozone.

FLUOSILICIC ACID. H_2SiF_6. *Syn.* HYDROFLUOSILICIC ACID. A double fluoride of hydrogen and silicon = $2HF.SiF_4$.

Prep. Mix 1 part of powdered fluor-spar with 1 part of fine sand or powdered glass, and heat it gently with two parts of concentrated sulphuric acid in a glass retort, the neck of which dips just under the surface of a layer of mercury contained at the bottom of a vessel of water. Silicon fluoride is evolved, and is decomposed by the water, fluosilicic acid being formed in solution and gelatinous silica being precipitated; this latter is prevented by the layer of mercury from blocking the delivery tube. The solution of the acid is used as a test for potassium and barium, as it gives nearly insoluble precipitates with the salts of these metals.

FLUX. *Syn.* FLUXUS, FLUOR, L. In *medicine*, a term formerly applied to several diseases attended with a copious discharge, as diarrhœa (FLUX), dysentery (BLOODY FLUX), English cholera (BILIOUS FLUX), fluor albus (WHITE FLUX), &c.

Flux. In *metallurgy*, &c., a term applied to various substances of easy fusibility, which are added to others which are more refractory, to facilitate their fusion.

Prep. 1. (BLACK FLUX.) Nitre, 1 part; crude tartar or cream of tartar, 2 parts; mix, and deflagrate, by small quantities at a time, in a crucible, heated to dull redness. The product consists of carbonate of potash mixed with charcoal in a finely divided state. It is used for smelting metallic ores. It exercises a reducing action, as well as facilitates the fusion. It must be kept dry.

2. (CHRISTISON'S FLUX.) Carbonate of soda (cryst.), 8 parts; charcoal (in fine powder), 1 part; heat the mixture gradually to redness. For reducing arsenic.

3. (CORNISH REDUCING FLUX.) Crude tartar, 10 parts; nitre, 4 parts; borax, 3 parts; triturate together.

4. (CORNISH REFINING FLUX, WHITE FLUX.) Crude tartar and nitre, equal parts, deflagrated together. See BLACK FLUX.

5. (CRUDE FLUX.) Same as BLACK FLUX, omitting the defragration. Reducing.

6. (FRESENIUS'S FLUX.) Carbonate of potash (dry), 3 parts; cyanide of potassium, 1 part. For the arsenical compounds.

7. (LIEBIG'S FLUX.) Carbonate of soda (dry) and cyanide of potassium, equal parts. As the last. See ARSENIOUS ACID.

8. (MORVEAU'S REDUCING FLUX.) Powdered glass (free from lead), 8 parts; calcined borax and charcoal, of each, 1 part; all in fine powder, and triturated well together. Used as BLACK FLUX.

9. (WHITE FLUX.) See *above*.

10. (FLUXES FOR ENAMELS.) See ENAMELS.

11. (Various.) Borax, tartar, nitre, sal-ammoniac, common salt, limestone, glass, fluor-spar, potassium cyanide, and several other substances, are used as fluxes in *metallurgy*.

Obs. On the large scale, crude tartar is employed in the preparation of fluxes; on the small scale, commercial cream of tartar or bitartrate of potash.

FLY. The common house-fly (*Musca domestica*) causes considerable annoyance to the person in hot weather, as well as damage to handsome furniture, especially to picture-frames, gilding, and the like. The best way to exterminate them is to expose on a plate one or other of the mixtures given under FLY POISON (*below*). The blow-fly (*Musca vomitoria*), and other insects, may be kept from attacking meat by dusting it over with black pepper, powdered ginger, or any other spice, or by skewering a piece of paper to it on which a drop or two of creosote has been poured. The spices may be readily washed off with water before dressing the meat.

It is a fact not generally known that flies will not pass through a netting made of fine silk, thread, or wire, even though the meshes may be an inch apart, unless there is a window or light behind it. This affords us a ready means of excluding the insects from all our apartments which have windows only on one side of them, without keeping the latter closed. It is merely necessary to have an ornamental netting stretched across the opening, when, although flies may abound on the outside, none will venture into the room so protected. If, however, there is a window on the other side of the room, they will fly through the netting immediately (see *below*).

Fly-blow in Sheep. Oil of turpentine, 3 oz.;

oil of amber, 1 oz.; corrosive sublimate, 1 dr. The sublimate must be first dissolved in a pint of whey and then mixed with the oils.

Fly Papers. 'PAPIER MOURE' contains a large quantity of arsenic in its substance. Mr Plowman, in a letter to the 'Pharm. Journ.,' June 22nd, 1878, says that in a specimen of 'papier moure' examined by him he failed to detect the least trace of arsenic. This paper is kept wet when in use, and the flies, by sipping the moisture, are poisoned.

Fly Poison. *Prep.* 1. A strong solution of white arsenic (say 1 dr. to the pint), sweetened with moist sugar, treacle, or honey. Sold under the name of 'FLY WATER.'

2. Treacle, honey, or moist sugar, mixed with about 1-12th their weight of King's yellow or orpiment.

Obs. Both the above are dangerous preparations, and should never be employed where there are children.

3. (*Redwood.*) Quassia chips (small), ¼ oz.; water, 1 pint; boil 10 minutes, strain, and add of treacle 4 oz. "Flies will drink this with avidity, and are soon destroyed by it."

4. Black pepper, 1 teaspoonful; brown sugar, 2 teaspoonfuls; cream, 4 teaspoonfuls (see *below*).

Fly Powder. The dark-grey coloured powder (so-called 'suboxide') obtained by the free exposure of metallic arsenic to the air. Mixed with sweets, it is used to kill flies.

Fly Water. See FLY POISON (*above*).

FOAM PRODUCER. For this either tincture of quillaia or tincture of senega is used. Either of these, in virtue of the saponin contained in them, produces a splendid head.

FOILS. These are thin leaves of polished metal, placed under precious stones and pastes, to heighten their brilliancy or to vary the effect. Foils were formerly made of copper, tinned copper, tin, and silvered copper, but the last is the one wholly used for superior work at the present day.

Foils are of two descriptions: white, for diamonds and mock diamonds; and coloured, for the coloured gems. The latter are prepared by varnishing or lacquering the former. By their judicious use the colour of a stone may often be modified and improved. Thus, by placing a yellow foil under a green stone that turns too much on the blue, or a red one under a stone turning too much on the crimson, the hues will be brightened and enriched in proportion.

Prep. 1. (CRYSTAL, DIAMOND, or WHITE FOIL.) *a.* This is made by coating a plate of copper with a layer of silver, and then rolling it into sheets in the flatting mill. The foil is then highly polished, or covered with crystal varnish.

b. The inside of the socket in which the stone or paste is to be set is covered with tin foil, by means of a little stiff gum or size; when dry, the surface is polished and the socket heated, and whilst it is warm, filled with quicksilver; after repose for 2 or 3 minutes the fluid metal is poured out, and the stone gently fitted in its place; lastly, the work is well fitted round the stone, to prevent alloy being shaken out.

c. The bottom of the stone is coated with a film of real silver, by precipitating it from a solution of the nitrate in spirit of ammonia, by means of the oils of cassia and cloves. See SILVERING. This method vastly increases the brilliancy both of real and factitious gems, and the work is very permanent.

2. (COLOURED FOILS.) The following formulæ produce beautiful coloured effects, when judiciously employed:

a. (Amethyst.) Lake and Prussian blue, finely ground in pale drying oil.

b. (Blue.) Prussian blue (preferably Turnbull's), ground with pale, quick-drying oil. Used to deepen the colour of sapphires.

c. (Eagle-marine.) Verdigris tempered in shell-lac varnish (alcoholic), with a little Prussian blue.

d. (Garnet.) Dragon's blood dissolved in rectified spirit of wine.

e. (Vinegar-garnet.) Orange lake finely tempered with shell-lac varnish.

f. (Green.) *α.* From pale shell-lac, dissolved in alcohol (lacquer), and tinged green by dissolving verdigris or acetate of copper in it.

β. From sesquiferrocyanide of iron and bichromate of potassa, of each, ½ oz.; ground to an impalpable powder, first alone, and then with gum-mastic (clean and also in fine powder), 2 oz.; a little pyroxilic spirit is next added, gradually, and the whole again ground until the mass becomes homogeneous and of a fine transparent green. The beauty increases with the length of the grinding. The predominance of the bichromate turns it on the yellowish-green; that of the salt of iron on the bluish-green. For use it is to be thinned with pyroxilic spirit ('Chem.,' iii, 231). Used for emeralds.

g. (Red.) Carmine, dissolved in spirit of hartshorn, or in a weak solution of salt of tartar, and a little gum (dissolved) added.

h. (Ruby.) *α.* From lake or carmine, ground in isinglass.

β. Lake ground in shell-lac varnish. Both are used when the colour turns on the purple.

γ. From bright lake ground in oil. Used when the colour turns on the scarlet or orange.

i. (Yellow.) *α.* Various shades of yellow may be produced by tinging a weak alcoholic solution of shell-lac or mastic, by digesting turmeric, annotta, saffron, or Socotrine aloes in it. The former is the brightest, and is used for topazes.

β. From hay saffron digested in 5 or 6 times its weight of boiling water until the latter becomes sufficiently coloured, and a little solution of gum or isinglass added to the filtered liquor. When dry, a coating of spirit varnish is applied.

Obs. By the skilful use of the above varnishes, good imitations of the gems may be cheaply made from transparent white glass or paste; and by applying them to foils set under coloured plates (FACTITIOUS GEMS), a superior effect may be produced. The pigments employed must be reduced to the finest state possible by patient grinding, as without this precaution transparent and beautiful shades cannot be formed. The palest and cleanest mastic and lac, dissolved in alcohol, and also the palest and quickest drying oil should alone be used when these substances are ordered. In every case the colour must be laid on the foil with a broad

soft brush; and the operation should be performed, if possible, at once, as no part should be crossed, or twice gone over, whilst wet. If the colour turns out too pale, a second coat may be given when the first one has become quite dry, but this practice should be avoided if possible.

FOMENTA'TION. *Syn.* FOMENTATIO, FOMENTUM, FOTUS, L. A liquid, either simple or medicated, used for local bathing. Fomentations are distinguished from lotions chiefly in being applied in a heated state, and in larger quantities, and for a longer period at a time.

Fomentations are chiefly employed to allay pain or irritation, or to promote suppuration or the healthy action of the parts. As the intention is to convey heat, combined with moisture, to the part fomented, the utmost care must be taken to manage the application so as to promote the object in view as much as possible. Flannel cloths wrung out of the hot or boiling liquid, by means of two sticks, turned in opposite directions, form the best vehicles for fomentations. If they are shaken up, and laid lightly over the part, they involve a considerable quantity of air, which, being a bad conductor, retains the heat in them for a considerable time. "In every process of fomenting there should be two flannels, each (say) 3 yards long, with the ends sewed together, to admit of the boiling water being wrung out of them; and the one flannel should be got ready whilst the other is applied. The fineness or coarseness of the flannel is not a matter of indifference. The coarser it is the less readily does it conduct heat, and the longer it retains its warmth; therefore it is more efficient for fomenting" (*Dr R. E. Griffith*). More harm than good is frequently done by allowing the patient to become chilled during the application. "If only one (flannel) is used, the skin becomes chilled during the time occupied in removing the flannel, soaking it in the water, wringing it out, and reapplying it; but if two are used, one of them is ready, and can be applied the moment the other is taken off, by which means the part is never exposed to the air, no matter how long the fomentation is continued. In some diseases (rheumatism, peritonitis, &c.), the patient is scarcely conscious of a degree of heat which scalds the nurse's hands. In this case the fomenting flannels should be put in a towel, by which means they may be wrung out without being handled by the nurse, and may be applied far hotter than can be done by any other method" (*Dr J. B. Nevins*).

The quantity of liquid forming a fomentation, as well as the size of the cloths employed, must entirely depend upon circumstances. In some cases (as in slight affections of the face, &c.) the application may be effectually made by holding the part in the steam of the hot liquid, and bathing it continually by means of a sponge or cloth. In some instances ½ pint to a pint of liquid may be found a sufficient quantity; whilst in others several quarts will be required. Under all circumstances, care must be taken to keep the fomentation as near as possible at the temperature ordered, during the whole time of its application; and, as soon as the operation is finished, to quickly wipe the part dry, and to cover it with ample clothing, in order that the reaction set up may not be prematurely checked.

Fomentations usually consist of simple water, or the decoction of some simple vegetable substance, as chamomiles, elder-flowers or mallows; but occasionally the leaves and flowers of aromatic and narcotic plants, and saline matter are employed under this form. The following formulæ are given as examples:

Fomentation, Acetic. *Syn.* FOTUS ACETICUS. (Paris Codex.) Fomentations of vinegar are sometimes prepared with white, with rose, or with aromatic vinegar (Paris Codex) in the proportion of one of vinegar to four of water.

Fomentation, An'odyne. *Syn.* FOTUS ANODYNUS, FOMENTATIO ANODYNA, FOMENTUM ANODYNUM, L. *Prep.* 1. Simple decoction of poppy-heads.

2. (Hosp. F.) Poppy-heads (without the seeds), 1½ oz.; water 3½ pints; boil to 2¼ pints; add of elder-flowers, ¾ oz.; boil to a quart and strain. Used to allay pain.

3. (*Pierquin.*) Opium, 1 oz.; wine, 1 quart; boil to a pint and strain. Used in severe gouty, rheumatic, neuralgic, and syphilitic pains.

4. Opium, 1 oz.; water, 1 quart; boil to ¾ pint, add pyroligneous acid, 2 fl. oz.; boil for 10 minutes longer, then further add of sherry wine, ¾ pint; and as soon as the whole again boils, strain it for use. Superior to the last, and cheaper.

Fomentation, Antineural'gic. *Syn.* FOMENTATIO ANTINEURALGICA, L. *Prep.* 1. (*Mialhe.*) Acetate of morphia, 2 gr.; acetic acid, 2 or 3 drops; eau de Cologne, 2 or 3 dr.; dissolve. In facial neuralgia.

2. (*Trousseau* and *Reveil.*) Cyanide of potassium, 1 dr.; distilled water, 6 fl. oz.; dissolve and keep it in a well-closed bottle in the dark. Used in neuralgia, especially in that of the face (tic douloureux). A compress of lint or soft linen is dipped in it and applied to the part. It must not be used internally or applied to a wounded surface, as it is very poisonous. See FOMENTATIONS (Anodyne), Nos. 3 and 4 (*above*); also FOMENTATION (Stimulant).

Fomentation, Antiseptic. *Syn.* FOMENTATIO ANTISEPTICA, L. *Prep.* 1. Decoction of mallows, 4 pints; sal-ammoniac, 2 oz.; dissolve, and add of disulphate of quinine, 20 gr., dissolved in camphorated spirit, 4 fl. oz.

2. (Hosp. F.) Decoction of bark, 1 quart; infusion of chamomile, 1 pint; camphorated spirit, 2 fl. oz.; hydrochloric acid, 1 fl. dr. Both are used when there is a tendency to gangrene or putrescence.

Fomentation of Ar'nica. *Syn.* FOMENTATIO ARNICÆ, L. *Prep.* 1. Flowers of arnica, 1 oz.; water, 3 pints; boil to a quart and strain. Used in contusions.

2. (*Graefe.*) Flowers of arnica, 2 oz.; rue (leaves), 1 oz.; boiling water, q. s. to strain 12 fl. oz. of infusion after an hour's maceration at nearly the boiling temperature. Used in contusions and extravasations, especially as an application to black eyes.

3. (*Radius.*) Flowers of arnica, ½ oz.; boiling vinegar, q. s. to strain 6 fl. oz. of infusion, in which dissolve of carbonate of ammonia, 2 dr. Used in œdema of the scrotum.

Fomentation, Aromat'ic. *Syn.* FOMENTATIO AROMATICA, FOTUS AROMATICUS, L. *Prep.* 1. Sea-wormwood, southernwood, and chamomiles, of each, 1 oz.; laurel-leaves, ½ oz.; water 5 pints; boil to ½ gall. and strain. In rheumatism, cutaneous affections, colic, &c.

2. (*Augustin.*) Rosemary, ½ oz.; red wine, and water, of each, 3 fl. oz.; infuse and strain with expression. In contusions, especially black eyes.

3. (Hosp. F.) Cloves and mace, of each, 1 oz.; opium, 20 gr.; red wine (boiling), 1 pint; digest at near boiling for 1 hour, and strain, Used as both the last.

4. (*Rideau.*) Bay-leaves, rosemary, southernwood, and wormwood, of each, 1 oz.; water, 2 quarts; boil 5 minutes and strain. As No. 1.

Fomentation, Astrin'gent. *Syn.* FOTUS ASTRINGENS, F. ROBORANS, L. *Prep.* 1. Decoction of oak-bark.

2. To each quart of the last add of alum 1 dr.

3. (Ph. Chirur.) Bruised galls, 1 oz.; boiling water, 2½ pints; digest 1 hour and strain.

4. (*Ricord.*) Tannin, 2½ dr.; aromatic wine (hot), ½ pint; dissolve.

5. Bistort and pomegranate peel, of each, 2 oz.; sal ammonia, ¼ oz.; red wine, 1 pint; infuse at a gentle heat. The above are used in hæmorrhages, piles, prolapsus, &c.

Fomentation of Belladon'na. *Syn.* FOTUS BELLADONNÆ, L. *Prep.* (Ophthalmic Hosp.) Extract of belladonna, 1 dr.; boiling water, 1 pint. Used to dilate the pupil in certain affections of the eye; it is usually applied on the forehead.

Fomentation of Cham'omile. *Syn.* FOMENTATIO ANTHEMIDIS, L. *Prep.* Chamomiles, 2 oz.; water, 3 pints; boil 10 minutes, and strain with expression. Emollient.

Fomentation, Com'mon. *Syn.* FOTUS COMMUNIS. (L. 1744.) *Prep.* Dried southernwood, sea-wormwood, chamomile, of each, 1 oz.; dried bay-leaves, ½ oz.; water, 5 pints; boil slightly, and strain.

Fomentation (Compound) of Hemlock. (Guy's Hosp.) *Syn.* FOMENTUM CONII COMPOSITUM. *Prep.* Dried hemlock, 2 oz.; dried chamomiles, ½ oz.; boiling water, 1½ pints; macerate for 2 hours, strain, and press.

Fomentation of El'der-flowers. *Syn.* FOTUS SAMBUCI, L. *Prep.* From elder-flowers, 1 oz.; boiling water, 2 quarts; digest in a hot place for 1 hour, and express the liquor. Emollient.

Fomentation, Emol'lient. *Syn.* FOMENTATIO EMOLLIENS, L. *Prep.* 1. Marsh-mallow root and poppy-heads, of each, 1 oz.; water, 3 pints; boil to a quart and strain.

2. (P. Cod.) Emollient herbs, 1 oz.; boiling water, 1 quart; infuse 1 hour and strain with expression. (See *above*).

Fomentation, Foxglove. *Syn.* FOMENTUM DIGITALIS. Dried foxglove, 1 oz.; boiling water, 1½ pints; infuse and strain.

Fomentation of Galls. *Syn.* FOMENTUM GALLÆ. *Prep.* Bruised galls, ½ oz.; boiling water, 2 lbs.; macerate for an hour, and strain.

Fomentation, Narcot'ic. *Syn.* FOMENTATIO NARCOTICA, L. *Prep.* (P. Cod.) Narcotic herbs, 1 oz.; boiling water, 1½ pints; infuse as last.

Fomentation, Poppy. *Syn.* FOMENTUM PAPAVERIS. As DECOCTION OF POPPIES.

Fomentation, Resol'vent. *Syn.* FOTUS RESOLVENS, L. *Prep.* (*Richard.*) Fomentation of elder-flowers, 8 fl. oz.; liquor of diacetate of lead, ½ fl. dr.; mix. Used to discuss tumours, &c.

Fomentation, Stim'ulant. *Syn.* FOMENTATIO STIMULANS, L. *Prep.* 1. Sesquicarbonate of ammonia, 1 oz.; tincture of cantharides, 2 fl. oz.; warm water, 1 pint.

2. Household mustard, 4 oz.; hot water, 1½ pints; mix. Both the above are rubefacient and counter-irritant, and excellent in rheumatism, neuralgia, &c.

Fomentation, Tannin. *Syn.* FOMENTUM TANNINI (*Ricord.*) *Prep.* Tannin, 2 dr.; aromatic wine, 8 oz.

Fomentation, Wine. *Syn.* FOTUS VINOSUS (Par. Cod.) *Prep.* Red wine, 2 pints; honey, 4 oz.

FOOD. *Syn.* CIBUS, MATERIA ALIMENTARIA, L. Anything which feeds or promotes the natural growth of organic bodies by supplying them with materials which, by assimilation, may be converted into the substances of which they are composed; or which, by its decomposition or slow combustion, maintains the temperature or some other essential condition of life at the proper standard. The numerous articles employed as food are all compounds; and in many cases they consist of mechanical mixtures or chemical combinations of two or more compounds. Organised matter, or that which has possessed either animal or vegetable life, or which has been produced by living organs, seems to be alone capable of assimilation to any extent by the animal system; and hence it is from the organic kingdom that our aliments are necessarily derived. Water, iron, earthy phosphates, chloride of sodium, and other salts, which form the inorganic constituents of the body, though not of themselves nourishing, are also assimilated when taken in conjunction with organic aliments, and then contribute essentially to nutrition. In the animal and vegetable substances employed as food, these inorganic compounds are provided in small but sufficient quantities to meet the requirements of the healthy body, and in this state of combination alone can they be regarded in the light of aliments. A complete consideration of this subject embraces, not only all the substances used as food, but also those things which when taken with them improve their flavour, promote their digestion, and render them more wholesome and nutritive; and also their preparation for the table in its various relations with health and disease.

The following 'BILLS OF FARE,' for which we are indebted chiefly to Soyer, Rundell, and others, exhibit the various articles in season at different periods of the year.

FIRST QUARTER.—January. Poultry and game: Pheasants, partridges, hares, rabbits, woodcocks, snipes, turkeys, capons, pullets, fowls, chickens, and tame pigeons. Fish: Carp, tench, perch, lampreys, eels, crayfish, cod, soles, flounders, plaice, turbot, thornback, skate, sturgeon, smelts, whitings, lobsters, crabs, prawns, and oysters. Vegetables: Cabbage, savoys, colewort, sprouts, leeks, onions, beet, sorrel, chervil, endive, spinach, celery, garlic,

scorzonera, potatoes, parsnips, turnips, brocoli (white and purple), shalots, lettuces, cresses mustard, rape, salsify, and herbs of all sorts (some dry and some green); cucumbers, asparagus, and mushrooms are also to be had, though not in season. Fruit: Apples, pears, nuts, walnuts, medlars, and grapes.

February and March. Meat, fowls, and game as in January, with the addition of ducklings and chickens. Fish: As the last two months (cod is not thought so good from February to July, although it is still sold at the fishmonger's). Vegetables: The same as the previous months, with the addition of kidney beans. Fruit: Apples, pears, and forced strawberries.

SECOND QUARTER. April, May, and June. Meat: Beef, mutton, veal, lamb, and venison (in June). Poultry: Pullets, fowls, chickens, ducklings, pigeons, rabbits, and leverets. Fish: Carp, tench, soles, smelts, eels, trout, turbot, lobsters, chub, salmon, herrings, crayfish, mackerel, crabs, prawns, and shrimps. Vegetables: As before; and in May, early potatoes and cabbages, peas, radishes, kidney beans, carrots, turnips, cauliflowers, asparagus, artichokes, and numerous salads (forced). Fruit (in June): Strawberries, cherries, melons, green apricots, and currants and gooseberries for tarts; pears, grapes, nectarines, peaches, and some other fruit.

THIRD QUARTER. July, August, and September. Meat, as before. Poultry, &c.: Pullets, fowls, chickens, rabbits, pigeons, green geese, leverets, and turkey poults. Two former months, plovers and wheat-ears (in September), partridges, geese, &c. Fish: Cod, haddocks, flounders, plaice, skate, thornback, mullets, pike, carp, eels, shell-fish (except oysters), and mackerel (during the first two months of the quarter, but they are not good in August). Vegetables: Of all sorts, beans, peas, French beans, &c. Fruit (in July): Strawberries, gooseberries, pineapples, plums (various), cherries, apricots, raspberries, melons, currants, and damsons; (in August and September) peaches, plums, figs, filberts, mulberries, cherries, apples, pears, nectarines, and grapes; (during the latter months) pines, melons, strawberries, medlars, and quinces; (in September) Morrella cherries, damsons, and various plums.

FOURTH QUARTER. October, November, and December. Meat as before, and doe venison. Poultry and game: Domestic fowls, as in first quarter; pheasants (from the 1st of October), partridges, larks, hares, dotterels (at the end of the month), wild ducks, teal, snipes, widgeon, and grouse. Fish: Dories, smelts, pike, perch, halibuts, brills, carp, salmon-trout, barbel, gudgeons, tench, and shell-fish. Vegetables: (As in January) French beans, last crops of beans, &c. Fruit: Peaches, pears, figs, bullace, grapes, apples, damsons, filberts, walnuts, nuts, quinces, services, and medlars. (In November) Meat, &c.: Beef, mutton, veal, pork, house-lamb, doe venison, and poultry and game as in last month. Fish: As the last month. Vegetables: Carrots, turnips, parsnips, potatoes, skirrets, scorzonera, onions, leeks, shalots, cabbage, savoys, colewort, spinach, chardbeats, chardoons, cresses, endive, celery, lettuces, salad-herbs, and various pot-herbs. Fruit: Pears, apples, nuts, walnuts, bullace, chestnuts, medlars, and grapes. (In December) Meat, &c.: Beef, mutton, veal, house-lamb, pork, and venison. Poultry and Game: Geese, turkeys, pullets, pigeons, capons, fowls, chickens, rabbits, hares, snipes, woodcocks, larks, pheasants, partridges, sea-fowls, guinea-fowls, wild ducks, teal, widgeon, dotterels, dun-birds, and grouse. Fish: Cod, turbot, halibuts, soles, gurnets, sturgeon, carp, gudgeons, codlings, eels, dories, and shell-fish. Vegetables: As in last month; asparagus, &c., forced. Fruit: As before, except bullace.

Food, Inspection of. The Public Health Act enacts that—

"Any medical officer of health or inspector of nuisances may at all *reasonable times* inspect and examine any animal, carcass, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk exposed for sale, or deposited in any place for the purpose of sale, or of preparation for sale, and intended for the food of man, the proof that the same was not exposed or deposited for any such purpose, or was not intended for the food of man, resting with the party charged; and if any such animal, carcass, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk, appears to such medical officer or inspector to be diseased, or unsound, or unwholesome, or unfit for the food of man, he may seize and carry away the same himself or by an assistant, in order to have the same dealt with by a justice" (P. H., s. 116).

"If it appears to the justice that any animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk, so seized is diseased, or unsound, or unwholesome, or unfit for the food of man, he shall condemn the same, and order it to be destroyed, or so disposed of as to prevent it from being exposed for sale, or used for such food; and the person to whom the same belongs or did belong at the time of sale, or of exposure for sale, or in whose possession, or on whose premises the same was found, shall be liable to a penalty not exceeding £20 for every animal, carcass, or fish, or piece of meat, flesh, or fish, or any poultry or game, or for the parcel of fruit, vegetables, corn, bread, or flour, or for the milk so condemned, or at the discretion of the justice without the infliction of a fine, to imprisonment for a term of not more than *three months.*

"The justice who, under this section, is empowered to convict the offender, may be either the justice who may have ordered the article to be disposed of or destroyed, or any other justice having jurisdiction in the place" (P. H., s. 117).

"Any person who in any manner prevents any medical officer of health or inspector of nuisances from entering any premises and inspecting any animal, carcass, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk exposed or deposited for the purpose of sale, or of preparation for sale, and intended for the food of man, or who obstructs or impedes any such officer or inspector, or his assistant, when carrying into execution the provisions of this Act, shall be liable to a penalty not exceeding £5" (P. H., s. 118).

"Any complaint made on oath by a medical officer of health, or by an inspector, or other offi-

cer of a local authority, any justice may grant a warrant to any such officer, to enter any building, or part of a building in which any such officer has reason for believing that there is kept or concealed any animal, carcass, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk which is intended for sale for the food of man, and is diseased, unsound or unwholesome or unfit for the food of man, and to search for, seize, and carry away any such animal, or other article, in order to have the same dealt with by a justice under the provisions of this Act.

"Any person who obstructs any such officer in the performance of his duty, under such warrant shall, in addition to any other punishment to which he may be subject, be liable to a penalty not exceeding £20" (P. H., s. 119).

Food Preservative. Boric acid is what is generally used for milk; a little borax is mixed with, but not more than 1-8th part. Latterly bicarbonate of soda has taken the place of the borax, as in the following formula: Boracic acid, 6 oz.; bicarbonate of soda, 4 oz. Both powders to be carefully dried and mixed intimately.

FOOL. Cooks give this name to a species of jam made of boiled and crushed fruit, mixed with milk or cream, and sweetened.

Fool, Ap′ple. From the peeled and cored fruit, placed in a jar, with moist sugar, q. s. to render it palatable, and a very little cider or perry; the jar is set in a saucepan of water over the fire, and the heat continued until the apples become quite soft, when they are pulped through a colander, and a sufficient quantity of milk, a little cream, and some sugar added, to bring them to the proper 'palate.'

Fool, Goose′berry. From gooseberries, as the last. Those which are unripe are generally preferred. These preparations, when nicely made are very pleasant and wholesome.

FOOT (Human). See FEET.

FOOTS. Coarse moist sugar. The scrapings of the sugar hogsheads, refuse sugar, waste, and dirt, is also sold to the publicans under this name, who use it in the adulteration of their beer; chiefly to make it stand more water, and to impart 'briskness.'

FORCE′MEAT. *Syn.* FARCE, STUFFING. A species of sausage-meat, either served up alone, or employed as an ingredient in other dishes.

Mrs Rundell truly remarks that "at many tables, where everything else is done well, it is common to find very bad forcemeat or stuffing." To avoid this error, care should be taken to so proportion the ingredients that "no one flavour should predominate; yet if several dishes be served the same day, there should be a marked variety in the tastes of the forcemeats as well as of the gravies. A general fault is, that the tastes of lemon peel and thyme overcome all others; therefore they should only be used in small quantities." Forcemeats should be just consistent enough to cut with a knife, but not dry and heavy. Herbs are very essential ingredients; and it is the copious and judicious use of them that chiefly gives the cookery of the French its superior flavour. "To force fowls, meat, &c., is to stuff them" (*Mrs Rundell*).

FOR′CING. Horticulturists apply this term to the art of accelerating the growth of plants, so as to obtain fruits or flowers at unusual seasons. Dung-beds, bark-beds, and frames, pits, and houses, with glass roofs, are commonly employed by the gardeners for this purpose.

FORGERIES, Protection from. See PAPER, PROTECTIVE.

FORMATE. *Syn.* FORMIATE. A salt of formic acid. The formates are best obtained either by direct saturation of the acid, or by double decomposition; most of them are very soluble, and are decomposed by hot oil of vitriol. Formate of ammonium crystallises in square prisms; formate of sodium in rhombic prisms; formate of potassium is deliquescent, and crystallises with difficulty; the formates of barium, calcium, magnesium, and strontium form small prismatic crystals; formate of lead assumes the shape of small colourless needles soluble in 40 parts of water; the formates of cobalt, iron, manganese, nickel, and zinc, are easily crystallisable, whilst that of copper forms very beautiful, large, bright-blue rhombic prisms; formate of silver is less soluble than the salt of lead, and is decomposed at a gentle heat.

FORMIC ACID. H.COOH. *Syn.* HYDROGEN FORMIATE. An organic acid, obtained by oxidising many organic substances, and found in the red ant and in stinging-nettles.

Prep. 1. Sugar, 1 part; water, 2 parts; binoxide of manganese, 3 parts; mix in a retort capable of holding fully 10 times the bulk of the ingredients, and add, cautiously, oil of vitriol, 3 parts, diluted with an equal weight of water; as soon as the first violent effervescence has subsided, heat may be applied, and the product of distillation collected and purified, as *below*.

2. From wood-spirit, 1 part; bichromate of potassium and sulphuric acid, of each, 3 parts; the sulphuric acid, diluted with an equal weight of water, is gradually added to the mixture of bichromate and wood-spirit, and the whole is then distilled. A portion of wood-spirit distils over with the acid, and may again be treated with bichromate of potassium and sulphuric acid, when a fresh portion of formic acid will be produced. This process yields a large product.

3. The best method is to heat oxalic acid with glycerine. Very concentrated glycerine is added to crystallised oxalic acid, and the mixture is heated to 100°—110° C. (212°—230° F.), when carbon dioxide escapes and dilute formic acid distils over. As soon as the evolution of gas ceases, more oxalic acid is added, and the heating continued, when a stronger formic acid distils over, and, on further addition of oxalic acid and heating, an acid of constant strength (56%) passes over.

Purific. By these processes dilute and, especially by method 1, somewhat impure acid is obtained. This may be concentrated and purified by neutralising it with sodium carbonate, purifying the resulting formate by recrystallisation, and if needful by animal charcoal, and distilling it with sulphuric acid. The acid thus obtained contains water. If it is required absolutely anhydrous, the product of methods 2 and 3, or that of 1, purified as above, should be saturated with lead oxide, the liquid evaporated to complete dry-

ness, and the dried lead formate powdered and very gently heated in a glass tube connected with a condensing apparatus, through which a current of dry sulphuretted hydrogen is passing. It is thus converted into lead sulphide, and anhydrous formic acid distils over.

Prop. Pure anhydrous formic acid is a clear colourless liquid with a very penetrating odour. It boils at about 100° C. (212° F.), and crystallises in large brilliant plates when cooled below 0° C. (32° F.). Its sp. gr. is 1·233. It fumes slightly in the air; its vapour is inflammable and burns with a blue flame. It is very corrosive, attacking the skin and forming a blister or ulcer which is very difficult to heal. It mixes with water, alcohol, and ether in all proportions. The aqueous acid has an odour and taste resembling those of acetic acid, but it may be distinguished from the latter by giving a black precipitate or a brilliant mirror of silver when it is heated with a solution of silver nitrate in a test-tube. Formic acid forms with bases salts called FORMATES (which *see*). It is a powerful reducing agent, reducing silver nitrate to the metal and mercuric chloride to calomel. When heated with oil of vitriol it yields carbon monoxide and water.

FORMICA. *Syn.* THE ANT. The following are the principal species of the genus *Formica*: *F. flava*, the yellow ant. Many careful observers say this species keeps in its nest the *Aphis radicans*, which when its abdomen is touched by the ant, excretes a saccharine substance on which the ants feed. *F. rufa*, or large red ant, *F. fusca*; or brown ant, *Polyergus rufescens*, and *F. sanguinea*. See ANT.

FORMOBENZOIC ACID. $C_8H_8O_3 = C_6H_5.CH(OH).COOH$. *Syn.* MANDELIC ACID, PHENYLGLYCOLLIC ACID. When the distilled water of bitter almonds (containing hydrocyanic acid and the essential oil) is boiled with hydrochloric acid, a curious reaction occurs; the hydrocyanic acid is decomposed—into ammonia which unites with the hydrochloric acid, and formic acid which enters into combination with the oil of almonds (benzoic aldehyde)—producing a new body possessed of acid properties, and termed *Formobenzoic acid.* On evaporating the solution the acid may be obtained mixed with ammonium chloride, from which it may be separated by ether; the ethereal solution deposits it in rhomboidal tables. It has a sour taste and is easily soluble in alcohol. When heated it fuses at a low temperature, emiting an agreeable odour of hawthorn blossoms (*Miller*).

FORMULA. [L.] In *pharmacy* and *medicine*, a short form of prescription; a recipe. By chemists the term is applied to a group of symbols expressing the composition of the body; thus, HCl (standing for 1 atom, or 1 part by weight, of hydrogen united to 1 atom, or 35·5 parts, of chlorine) is the formula for hydrochloric acid. A chemical formula is termed empirical when it merely gives the simplest possible expression of the composition of the substance to which it refers. A rational formula, on the contrary, aims at describing the exact composition of the molecule of the substance, and tells us the exact number of atoms of each element in that molecule, as well as indicating the composition by weight of the substance. Rational formulæ may also be further elaborated so as to express in a kind of shorthand notation the most characteristic properties of the substances they represent, but in this form they are intelligible to none but a chemist, and a detailed description of them would be out of place in the present work. The empirical formula is at once deduced from the analysis of the substance. To determine the rational formula other data are required in addition, such as the density of the substance when in a state of vapour, and a knowledge of the more important reactions which the body affords, and of the methods by which it may be synthesised. Thus, the composition of acetic acid is expressed by the formula CH_2O, which exhibits the simplest relations of the three elements; if we want to express the quantities of these, in atoms, required to make up one molecule of acetic acid, we have to adopt the formula $C_2H_4O_2$ or $HC_2H_3O_2$.

FOXGLOVE. *Syn.* DIGITALIS (B. P.), L. A genus of plants belonging to the Nat. Ord. SCROPHULARIACEÆ. The leaves of the uncultivated *Digitalis purpurea*, or purple foxglove, are *officinal* in our pharmacopœias. They must be gathered before the terminal flowers have expanded. "The petiole and midrib of the leaf being cut off, dry the lamina" (Ph. L.). The seeds (DIGITALIS SEMINA), which were ordered as well as the leaves in former pharmacopœias, are said to be in many points preferable to them. When good, the leaves are of a dull-green colour, and possess a feeble narcotic odour, and a bitter, unpleasant taste. Both the dried leaves and the powder should be preserved in corked bottles covered with dark-coloured paper, or in well-closed tin canisters, and kept in a dark cupboard; and the stock should be renewed yearly, as age considerably diminishes the medicinal activity of digitalis.

Action, uses, &c. Foxglove is diuretic, sedative, and antispasmodic, and exerts a specific action over the cerebro-spinal system, promoting the functions of the absorbents, and reducing the force of the circulation in a remarkable manner. It is administered in fevers and inflammations, to reduce the frequency of the pulse, and to allay excessive vascular excitement; in dropsy (unless the habit is full and pulse tight and cordy), as a diuretic, either alone, or combined with squills, calomel, salines, or bitters; in internal hæmorrhages, as a sedative, when the pulse is full, hard, and throbbing; in diseases of the heart and great vessels, and in phthisis, to reduce the force and velocity of the circulation; in epilepsy and insanity, to repress vascular excitement; and in spasmodic asthma, scrofula, and several other diseases, with one or other of the above intentions.

The greatest caution is required in the use of preparations of digitalis.—*Dose*, $\frac{1}{2}$ gr. to $1\frac{1}{2}$ gr., in powder, every 6 hours. See DIGITALIS, EXTRACT, INFUSION, TINCTURE, &c.

FOX'ING. See MALT LIQUORS.

FRACT'URE. *Syn.* FRACTURA, L. The breaking disrupture of a bone. When the bone is merely divided into two parts, it is called a SIMPLE FRACTURE; when the integuments are also lace-

rated, a COMPOUND FRACTURE; and when the bone is splintered, a COMMINUTED FRACTURE.

In rendering assistance to a person suffering from a fracture, no attempt should be made by an unskilled person to 'set' the bone, but the part should be supported by the use of some temporary splint secured by a bandage, and placed in such a position that the broken bones have no strain upon them, and move as little as possible. Umbrellas and walking-sticks, hedge-stakes, broom handles, and even bundles of straw or rushes make excellent support for broken legs. Never take off the patient's clothing, but, if necessary, *cut* it off.

FRAGRANT PAIN-CURER (Five-minute). (*Dr Walter Scott*, New York.) A remedy to remove all kinds of pain in 5 minutes. A clear, colourless fluid, containing ether, 6 grms.; glycerin, 21 grms.; common salt, 3·4 grms.; distilled water, 170 grms. (*Hager*).

FRANK'INCENSE. *Syn.* COMMON FRANKINCENSE; THUS (Ph. L.), L. The turpentine which exudes from the bark of *Abies excelsa* (Norway spruce-fir) and *Pinus palustris* (pitch or swamp pine), hardened by the air (Ph. L.). The gum-resin olibanum, which is the produce of *Boswellia thurifera*, is the 'odorous frankincense' of commerce.

Prepared Frankincense. *Syn.* THUS PRÆPARATUM (Ph. L.), L. *Prep.* (Ph. L.) Frankincense, 1 lb.; water, q. s. to cover it; boil until the resin is melted, and strain through a hair-sieve; when the whole has cooled, pour off the water, and keep the frankincense for use. Resembles common resin in its general properties.

FRAX'ININ. *Syn.* FRAXIN; FRAXINA, L. A peculiar bitter, neutral, and crystallisable substance, soluble in boiling water, extracted from the bark of *Fraxinus excelsior*, or common ash. It is febrifuge.

FREC'KLES. These are round or oval-shaped yellowish spots, similar to stains, developed on the skin. There are two varieties—FRECKLES, or SUMMER FRECKLES, resulting from the action of the sun and heat during the summer season, and disappearing with the hot weather or exposure; and COLD FRECKLES, which occur at all times of the year. The former are chiefly confined to persons of fair complexion, whilst the latter attack persons of all complexions indifferently, and sometimes assume a lively yellow or greenish colour.

Treatm. Common freckles may generally be removed by the frequent application of dilute spirits, acids or alkaline solutions; the last two just strong enough to prick the tongue. Cold freckles commonly occur from disordered health, or some general disturbance of the system, to which attention should be chiefly directed. In both varieties the solution of bichloride of mercury (Ph. L.), or Gowland's lotion, will be found a most useful external application (see *below*).

Freckles, Lotion for. *Prep.* 1. Bichloride of mercury, 5 gr.; hydrochloric acid, 30 drops; lump sugar, 1 oz.; rectified spirit of wine, 2 oz.; rose-water, 7 oz.; agitate together until the whole is dissolved.

2. Petals or leaves of red roses, 1 oz.; hot water, 12 fl. oz.; infuse an hour and strain, with expression, ½ pint; add of citric acid, 30 gr.; dissolve, and in a few hours decant and clear.

3. Rose-leaves (dried), ¼ oz.; lemon juice (freshly expressed) and rum or brandy, of each, ¼ pint; digest 24 hours, and squeeze out the liquor for use.

5. (*Kittoe's.*) Sal-ammoniac, 1 dr.; spring water, 1 pint; lavender-water or eau de Cologne, ¼ oz.; mix. The above are applied with the fingers night and morning, or oftener.

Freckles, Pomade for. *Prep.* 1. Citrine ointment, 1 dr.; simple ointment, 7 dr.; otto of roses, 3 drops.

2. Elder-flower ointment, 1 oz.; sulphate of zinc (levigated), 20 gr.; mix by porphyrization, or by trituration in a wedgewood-ware mortar. Both the above, applied night and morning, are excellent for either cold or summer freckles.

FREEZ'ING MIXTURES. See ICE and REFRIGERATION.

FRENCH BER'RIES. *Syn.* PERSIAN BERRIES, AVIGNON B.; GRAINES D'AVIGNON, Fr. The unripe berries or fruit of the *Rhamnus infectorius*. They are imported from France and Persia; those from the latter country being esteemed the best. Some writers state that the Persian berries are the product of a distinct species, namely, *R. amygdalinus*. They are chiefly used for dyeing morocco leather yellow. Their decoction dyes cloth, previously mordanted with alum, tartar, or protochloride of tin, of a yellow colour; with sulphate of copper, an olive; and with red sulphate of iron, an olive-green colour.

FRENCH POL'ISH. Several varnishes are used under this name. That most generally employed is a simple solution of pale shell-lac in either methylated spirit or wood-naphtha. Sometimes a little mastic, sandarac, or elemi, or copal varnish, is added to render the polish tougher.

Prep. 1. From pale shell-lac, 5½ oz.; finest wood-naphtha, 1 pint; dissolve.

2. Pale shell-lac, 3 lbs.; wood-naphtha, 1 gall. Methylated spirit (68 o. p.) may be substituted for the naphtha in each of the above formulæ.

3. Pale shell-lac, 5 oz.; gum-sandarac, 1 oz.; spirit (68 o. p.), 1 pint.

4. Pale shell-lac, 5½ oz.; gum-elemi, ¾ oz.; spirit, 1 pint.

5. Pale shell-lac, 1¼ lbs.; mastic, ¼ lb.; spirit, 2 quarts.

6. Pale shell-lac, 2¼ lbs.; mastic and sandarac, of each, 3 oz.; spirit, 1 gall.; dissolve, add copal varnish, 1 pint, and mix by roughly agitating the vessel. All the above are used in the manner described below.

7. Shell-lac, 12 oz.; wood-naphtha, 1 quart; dissolve, and add of linseed oil, ½ pint.

8. Shell-lac, ½ lb.; gum-sandarac, ¼ lb.; spirit, 1 quart; dissolve, add of copal varnish, ¼ pint; mix well, and further add of linseed oil, ½ pint. The last two require no oil on the rubber.

Obs. The preparation of French polish is precisely similar to that of other spirit or naphthalic varnishes. Sometimes it is coloured, in order to modify the character of the wood. A REDDISH TINGE is given with dragon's blood, alkanet root, or red sanders wood; and a YEL-

LOWISH TINGE, by turmeric root or gamboge. When it is simply desired to DARKEN the wood, brown shell-lac is employed to make the polish; and when the object is to keep the wood LIGHT COLOURED, a little oxalic acid (2 to 4 dr. to the pint) is commonly added. These substances are either steeped in or agitated with the polish, or with the solvent, before pouring it on the 'gums,' until they dissolve, or a sufficient effect is produced. French polish is not required to be so clear and limpid as other varnishes, and is, therefore, never artificially clarified. See VARNISH, and *below*.

FRENCH POL'ISHING. This process, now so generally employed for furniture and cabinet work is performed as follows:—The surface to be operated on being finished off as smoothly as possible with glass paper, and placed opposite the light, the 'rubber' being made as directed below, and the polish (see *above*) being at hand, and preferably contained in a narrow-necked bottle, the workman moistens the middle or flat face of the rubber with the polish by laying the rubber on the mouth of the bottle and shaking up the varnish against it once, by which means the rubber imbibes the proper quantity to cover a considerable extent of surface. He next encloses the rubber in a soft linen cloth, doubled, the rest of the cloth being gathered up at the back of the rubber to form a handle. The face of the linen is now moistened with a little raw linseed oil, applied with the finger to the middle of it, and the operation of polishing immediately commenced. For this purpose the workman passes his rubber quickly and lightly over the surface uniformly in one direction, until the varnish becomes dry, or nearly so, when he again charges his rubber as before, omitting the oil, and repeats the rubbing, until three coats are laid on. He now applies a little oil to the rubber, and two coats more are commonly given. As soon as the coating of varnish has acquired some thickness, he wets the inside of the linen cloth, before applying the varnish, with alcohol, or wood-naphtha, and gives a quick, light, and uniform touch over the whole surface. The work is, lastly, carefully gone over with the linen cloth, moistened with a little oil and rectified spirit or naphtha, without varnish, and rubbed, as before, until dry.

The RUBBER for French polishing is made by rolling up a strip of thick woollen cloth (list) which has been torn off, so as to form a soft elastic edge. It should form a coil from 1 to 3 inches in diameter, according to the size of the work.

FRICANDEAU. [Fr.] Among *cooks*, a ragoût, or fricassée of veal. The same term is also sometimes applied to stewed beef, highly seasoned.

FRICASSEE. [Fr.] A dish prepared by stewing or semi-frying, highly flavoured with herbs, spices, or sauce. Small things, as chickens, lamb, &c., and cold meat are usually formed into fricassees.

FRIC'TION. In a general sense, the act of rubbing one body against another; attrition.

Friction. In *mechanics*, this is the resistance which the surface of a moving body meets with from the surface of the body on which it moves. To lessen the amount of friction in machines, various unctuous substances, as oil, tallow, soap, black-lead, &c., are used by engineers. These substances act by imparting smoothness to the points of contact, and thus reduce their resistance to each other. The full consideration of the subject belongs to engineering.

FRIGORIFIC MIXTURES. See REFRIGERATION.

FRIT. The pulverulent materials of glass, heated until they coalesce without melting. See ENAMEL, GLASS, &c.

FRIT'TERS. Fried batter. A species of pancake, containing fruit, sweetmeats, poultry, meat, or fish.

Prep. 1. (*M. Alexis Soyer.*) "The following is thirty receipts in one:"—Soak crumb of bread, 1 lb., in cold water, q. s.; take the same quantity of any kind of boiled or roasted meat (a little fat), and chop it into fine dice; press the water out of the bread; put into the pan butter, lard, or dripping, 2 oz., with chopped onions, 2 teaspoonfuls; fry 2 minutes, add the bread, stir with a wooden spoon until rather dry, then add the meat, and season with salt, 1 teaspoonful, pepper, $\frac{1}{2}$ do., and a little grated nutmeg if handy; stir till quite hot; then further add 2 eggs, one at a time, mix very quickly, and pour it on a dish to cool; next roll it into the shape of small eggs, then in flour, 'egg' them, and bread-crumb them; lastly, fry in abundance of fat to a nice yellow colour, and serve either plain or with any sharp or other savoury sauce you fancy. Innumerable dishes can be made in this way; in fact, from everything that is eatable, and at any season of the year—from the remains of meat, poultry, game, fish, vegetables, &c. The same can be done with chopped, dried, or preserved fruits, simply using $\frac{1}{4}$ lb. more bread, and sifting powdered sugar and cinnamon over them. Cream may also be used for fruit, or curds.

Fritters are also (and more commonly) fried in ordinary batter, instead of bread-crumbs. "There is no end to what may be done with these receipts." "They can be ornamented and made worthy the table of the greatest epicure if the bread be soaked in cream, and spirits or liquor introduced into them" (*Soyer*).

2. (*Mrs Rundell.*) *a.* (APPLE FRITTERS.) See FRUIT FRITTERS.

b. (BUCKWHEAT FRITTERS, B. CAKES, BOCKINGS.) Made by beating up buckwheat flour to a batter with some warm milk, adding a little yeast, letting it rise before the fire for 30 or 40 minutes, then beating in some eggs and milk or warm water, as required, and frying them like pancakes. Buckwheat fritters, when well prepared, are excellent. Made without eggs and served up with molasses, they form a common dish in almost every breakfast in North America.

c. (CURD FRITTERS.) From dried curd, beaten with yelk of egg and a little flour, and flavoured with nutmeg.

d. (FRENCH FRITTERS.) Common pancakes, beaten up with eggs, almonds, and flavouring sugar, orange-flower water, and nutmeg, and the paste dropped into a stew- or frying-pan half full of boiling lard, so as to form cakes the size of large nuts, which are cooked till brown.

e. (Fruit Fritters.) From the sliced fruits, with rich batter.

f. (Soufflé Fritters.) Rich pancakes, flavoured with lemon.

g. (Spanish fritters.) From slices of French rolls soaked in a mixture of cream, eggs, sugar, and spices, and fried brown.

FROG. The esculent variety, in Europe, is the common green or gibbous frog, the *Rana esculenta* of Linnæus. As an aliment it is much esteemed on the Continent, the hind legs only being eaten. Its liver is among the simples of the Ph. L. 1618, and was once considered a useful remedy in certain forms of ague.

The Americans eat the bull-frog (the *Rana taurina*). This variety of the edible frog, which is a native of the Northern States, and is much prized as a table delicacy, has been lately introduced into France by the Societé d'Acclimatisation. Its flesh, when cooked, is said to have taste very like that of turtle. In South Africa a large frog called Matlamétlo is eaten. Frogs are also favourite food with the natives of China and Australia.

FROG OINTMENT, or Thrush Mixture. Brown syrup, 90 grms.; verdigris, 6 grms.; strong acetic acid, 10 grms.; solution of perchloride of iron, 2 grms. (*Hager*).

FROSTBEULENTINCTUR, FROSTBEULENWASSER—Chilblain Tincture, Chilblain Water. Manufactured by a chiropodist of Munich. It is a solution of 2 grms. zinc sulphate in 60 grms. water (*Wittstein*).

FROST-BITES. When those parts of the body in which the circulation of the blood is most languid are exposed to extreme cold they quickly become frozen, or, as it is called, 'frost-bitten.' The fingers, toes, ears, nose, and chin are most liable to this attack. The remedy is long-continued friction with the hands or cold flannel, avoiding the fire, or even a heated apartment.

FROSTSALBE — Frost Ointment (*Wahler*). (Kupferzell.) Mutton tallow, 24 parts; hog's lard, 24 parts; iron oxide, 4 parts; heat it in an iron vessel, stirring continually with an iron rod until the whole has become black; then add 4 parts Venice turpentine, 2 parts bergamot oil, and 2 parts Armenian bole rubbed smooth with olive oil.

FRUIT. *Syn.* Fructus, L. Among botanists this is the mature ovary or pistil, containing the ripened ovules or seeds. In familiar language, the term is applied to any product of a plant containing the seed, more especially those that are eatable.

Fruits are extensively employed as articles of diet by man, both as luxuries and nutriment. The fruit of the cereals furnishes our daily bread; that of the vine gives us the well-known beverage, wine, whilst other varieties enrich our desserts, and provide us with some of our most valuable condiments and aromatics. The acidulous and subacid fruits are antiseptic, aperient, attenuant, diuretic, and refrigerant. They afford little nourishment, and are apt to promote diarrhœa and flatulency. They are, however, occasionally exhibited medicinally, in putrid affections, and are often useful in bilious and dyspeptic complaints. The farinaceous fruits (grain), as already stated, furnish the principal and most useful portion of the food of man. The oleo-farinaceous (nuts, &c.) are less wholesome and less easy of digestion than those purely farinaceous. The saccharine fruits, or those abounding in sugar, are nutritious and laxative, but are apt to ferment and disagree with delicate stomachs when eaten in excess. Stone fruits are more difficult of digestion than the other varieties, and are very apt to disorder the stomach and bowels.

As a rule, fruit should never be eaten in large quantities at a time, and only when quite ripe. It then appears to be exceedingly wholesome, exercises a powerful action on the skin, and is a specific for scurvy in its early stages. Many cutaneous diseases may likewise be removed by the daily use of a moderate quantity of fruit, or other fresh vegetable food. Cases are not uncommon which, after resisting every variety of ordinary medical treatment, yield to a mixed fruit or vegetable diet.

Fruits should be gathered in dry weather, and preferably about noon, because the dew and moisture deposited on them during the night and earlier part of the morning has then evaporated. They should be quite ripe when gathered, but the sooner they are removed from the tree after this point is arrived at the better. Immature fruit never keeps so well as that which has ripened on the tree; and over-ripe fruit is liable to be bruised and to lose flavour. The less fruit is handled in gathering the better. Some of them, as peaches, nectarines, grapes, plums, &c., require to be treated with great delicacy to avoid bruising them or rubbing off the bloom. Some fruit, as a few varieties of apples, pears, and oranges, &c., are gathered before they are fully ripe, in order that they may the better undergo the perils of transit and storage.

Pres. Ripe fruits are commonly preserved in the fresh state by placing them in a cool dry situation, on shelves, so that they do not touch each other; or by packing them in clean, dry sand, sawdust, straw, bran, or any similar substance, with like care, to preserve them from the action of air and moisture. An excellent plan, commonly adopted for dessert fruit in this country, is to wrap each separately in a piece of clean dry paper, and to fill small wide-mouthed jars or honey-pots with them. The filled pots are then packed one upon another (see *engr.*) in a dry and cold place (as a cellar), where the frost cannot reach them. The space (*a*) between the two pots may be advantageously filled up with plaster of Paris made into a paste with water. The joint is thus rendered air-tight, and the fruit will keep good for a long time. The mouth of the top jar is covered with a slate. For use the jars should be taken one at a time from the store-room as wanted, and the fruit exposed for a week or ten days in a warm dry room before being eaten, by which the flavour is much improved.

1.

2.

Fruit is preserved on the large scale for the London market by placing in a cool situation first a layer of straw or paper, and so on alternately, to the height of 20 or 25 inches, which

cannot be well exceeded, as the weight of the superincumbent fruit is apt to crush or injure the lower layers. Sometimes alternate layers of fruit and paper are arranged in baskets or hampers, which are then placed in the cellar or fruit-room. The baskets admit of being piled one over the other without injury to the fruit. The use of brown paper is inadmissible for the above purposes, as it conveys its peculiar flavour to the fruit. Thick white-brown paper is the cheapest and the best.

Fruit Essences (Artificial). These remarkable products first attracted attention at the Exhibition of 1851. To speak somewhat generally, they are mixtures of amylic, butyric, pelargonic, valerianic, and other ethers, in alcohol. By judicious mixture, the flavour of almost any fruit can be more or less perfectly imitated. The artificial essences are generally coloured to represent the juice of the fruit from which they are supposed to be derived. The ESSENCE OF JARGONELLE PEAR and the ESSENCE OF APPLE, which are, perhaps, the best of all the artificial essences, are, respectively formed from the ACETATE and VALERIANATE OF AMYL. See AMYL, ESSENCE, &c.

FRU'MENTY. Wheat boiled in water until quite soft, then taken out, drained, thinned with milk, sweetened with sugar, and flavoured with nutmeg. When currants and eggs are added, it forms 'SOMERSETSHIRE FRUMENTY.' Some persons boil the wheat like rice. "Eaten with milk in the evening, for some time, it will often relieve costiveness' (*Griffith*).

FRY'ING. "The frying-pan is, without doubt, the most useful of all kitchen implements, and, like a good-natured servant, is often imposed upon and obliged to do all the work, while its companion, the gridiron, is quietly reposing in the chimney corner." "The usual complaint of food being rendered greasy by frying is totally remedied by sautéing the meat in a small quantity of fat, butter, or oil, which has attained a proper degree of heat, instead of placing it in cold fat, and letting it soak while melting." "According to the (common) mode in which all objects are cooked which are called fried, it would answer to the French word 'sauté,' or the old English term 'frizzle;' but to fry any object it should be immersed in very hot fat, oil, or butter." "To frizzle, sauté, or, as I will now designate it, semi-fry, is to place in the pan any oleaginous substance, so that, when melted, it shall cover the bottom of the pan by about 2 lines; and when hot, the article to be cooked is to be placed therein. To do it to perfection requires a little attention, so that the pan shall never get too hot. It should also be perfectly clean—a great deal depends on this" (*Soyer*).

According to the writer quoted above, a chop or steak, for frying, should be chosen ¾ of an in. thick, and should never "exceed 1 in., nor be less than ½ in., and to be as near as possible of the same thickness all over." "An ill-cut chop (or steak) never can be but ill-cooked; you can always equalise them (when badly cut) by beating them out with a chopper."

"The motive of semi-frying food is to have it done quickly; therefore, to fry a whole fowl, or even half (for example), is useless, as it could be cooked in a different way in the same time; but to semi-fry a fowl (in joints or pieces), with the object of having it quickly placed on the table, in order to satisfy a good, and perhaps fastidious appetite, it should be done in a similar way to that practised in Egypt some 3000 years since, and of late years for the great Napoleon —that is, cooked in oil. In France this dish is called, '*Poulet à la Marengo.*' It is related that the great conqueror, after having gained that celebrated victory, ate three small chickens at one meal done in this way, and his appetite and taste were so good, and he approved of them so highly, that he desired that they might always be served in the same way during the campaign."

"For many objects I prefer the frying-pan to the gridiron—that is, if the pan is properly used. As regards economy, it is preferable, securing all the fat and gravy, which is often lost when the gridiron is used." "This simple *batterie de cuisine* may be employed equally as well in the cottage as in the palace, or in the bachelor's chamber as in the rooms of the poor" (*Soyer*).

FUCHSIN. *Syn.* ANILINE RED, AZALCINE, SOLFERINO, &c. A red pigment or dye, consisting of rosaniline, hydrochloride, or acetate.

Prep. It is prepared from aniline oil by the application of various reagents, as, for instance: Chloride of tin, Verguin's method; carbon tetrachloride, Hofmann and Natanson's methods; mercuric nitrate, Gerber-Keller; mercuric chloride, Schnitzer; nitric acid, Lauth and Depouilly; antimonic acid, Smith; arsenic acid, Medlock, Girard and de Laire; aniline oil, nitro-toluol, hydrochloric acid, and metallic iron, Coupier. 100 parts of aniline oil yield 25 to 33 parts of crystallised fuchsin. The arsenic acid method is generally employed.

Girard and de Laire. 1 cwt. of aniline oil and 2 cwt. of hydrate of arsenic acid (sp. gr. 1·71) are heated together for 4 to 5 hours at a temperature which should not exceed 190°—200° C. The red mass obtained is broken into small lumps, and boiled with water; the solution is then filtered and poured into tanks, where it is allowed to stand 2 or 3 days to crystallise; the mother-liquor is then run off into water-tight tanks, and a mixture of chalk and lime is added in order to precipitate the arsenic and arsenious acids. The fuchsin thus obtained always contains arsenic, and when it is desired to use a salt of rosaniline for colouring liqueurs and sweetmeats, it is necessary to employ chloride of carbon or mercuric chloride in its preparation.

Prop. Fuchsin exhibits by reflected light a green golden hue; by transmitted light the colour is red. Its solution in water or in alcohol has a magnificent carmine red colour, fuchsin will dye 200 times its weight of wool. It is the basis of nearly all other aniline colours.

FUCUS'AMID, FU'CUSINE, and FU'CUSOL. Compounds obtained by Dr Stenhouse from several varieties of FUCUS by treatment with sulphuric acid, as in the preparation of FURFURINE (which *see*).

FUCUS VESICULOSUS. *Syn.* BLADDER-WRACK, SEA-WRACK. This common seaweed is

rich in salts of iodine, chlorine, and bromine. It has gained a reputation for reducing corpulence. A liquid extract is sold as 'Antifat.'—*Dose*, 1 to 2 dr.

FU'EL. Matter used for the production of heat by burning. The principal substances employed as fuel are—ANTHRACITE, CHARCOAL, COAL GAS, COKE, OIL, PITCOAL, SPIRIT, TURF, and WOOD.

The heating power of almost every description of fuel has been determined by the direct experiments of Lavoisier, Regnault, Andrews, and others; the general principle of their methods consisting in the use of an apparatus wherein the entire heat of combustion was absorbed by a known weight of water, the whole arrangement being protected from the influence of external changes of temperature, and the increase of the temperature of the water being known by the simultaneous indication of several delicate thermometers suspended in it. The real value of such determinations is simply relative. The imperfect character of most boiler and furnace arrangements, and the large quantity of fuel which passes into the 'ash-pit' unconsumed, together with the irregular 'draught,' and the amount of heat absorbed by excess of cold air, result practically in an enormous loss of heating power, even under the most careful management. The mechanical condition of a fuel must be considered in estimating its value. For naval use the toughness of the coal must be such as to resist, without crumbling, the constant friction in the ship's hold, at the same time its 'fracture' must be such that it packs into the smallest possible space. (For full information on coal and other fuels, refer to Ure's 'Dict. of Arts, Manufactures, &c.;' Percy's 'Metallurgy;' and Watt's 'Dict. of Chemistry.')

In the *chemical laboratory*, COAL GAS is now generally employed as fuel. It is cheap and manageable, and, with proper apparatus, may be made to supply almost any amount of heat. Where gas cannot be conveniently procured, OIL and SPIRIT are used as fuel for lamps. See ANTHRACITE, CHARCOAL, COKE, FURNACE, PITCOAL, &c., also *below*.

Fuel, Artificial. There are many kinds of artificial fuel in use, consisting of small coal or coke, sawdust, &c., mixed with tar, compressed, and moulded into bricks. Compressed peat and compressed spent tar are also used as fuel.

Briquettes. These are much used at present, and are made by heating strongly caking coal in closed vessels from 260°—400° C., and then compressing in moulds the product obtained. The manufacture of briquettes is sometimes carried on together with the preparation of tar and the manufacture of benzol, carbolic acid, naphthalene, &c.

The calorific value of a fuel may also be determined by its elementary analysis, the carbon and hydrogen being estimated in the usual way by the combustion of the fuel in a tube containing cupric oxide. The carbonic acid formed is absorbed by potash solution in a potash bulb, which is weighed before and after the experiment, and the water is absorbed by calcium chloride in a tube, which is also weighed before and after the experiment. The weights of carbon and hydrogen in the fuel can be deduced.

Fuel, Econom'ical. Various mixtures have been recommended under this name. The following is one of the best:

Prep. Small coal, charcoal, or sawdust, 1 part; clay, loam, or marl, 1 part; sand, or ashes, 2 parts; water, q. s.; make the mass up wet into balls. For use these balls are piled on an ordinary fire to a little above the top bar. They are said to produce a heat considerably more intense than that of common fuel, and ensure a saving of one half the quantity of coals, whilst a fire thus made up will require no stirring or fresh fuel for ten hours. The quantity of the combustible ingredient in them should be doubled, when they are intended to be used with a very little foundation of coal.

Obs. FIRE-CLAY BALLS are sometimes used for radiating heat from parlour grates, and so effecting saving in the consumption of fuel. They are very useful for partially filling up those roomy, old-fashioned, badly constructed grates, which are still to be found in many private houses.

PEAT and TURF, both recent and charred, are commonly used as fuel by the lower classes, in neighbourhoods where they are plentiful. FIR CONES or TOPS contain a great quantity of solid wood in addition to the resinous matter, and are well adapted for domestic fires.

FULLER'S EARTH. *Syn.* CIMOLIA, C. TERRA, L. A soft, unctuous, friable, greenish or yellowish-grey species of clay, containing 53% of silica, 10% of alumina, and about 9% of oxide of iron. After being dug out of the earth it is thoroughly dried in ovens, and then thrown into cold water, where it soon falls to powder, and is purified by the common process of edulcoration or washing-over. It is extensively used to extract oil and grease from cloth in the process of 'fulling;' it forms an excellent filtering powder for oils, and is applied as a cooling and healing dressing by the poor to inflamed breasts, excoriations, &c. Mixed with a little oxide of zinc and 1 per 1000 salicylic acid, it is an admirable application to chapped parts, or tender feet.

FULMINATES (Composition of). The true fulminates are derivatives of fulminic acid, nitro-acetonitrite, $CH_2(NO_2)CN$, and are formed from it by the replacement of the hydrogen by a metal. The formula of the silver fulminate is $CAg_2(NO_2)CN$, and that of the mercury fulminate $CHg(NO_2)CN$.

FULMINATING COMPOUNDS. These are numerous, and are scattered among several distinct classes of bodies. Among the most powerful and dangerous are the chloride and iodide of nitrogen and the fulminates of silver and mercury.

Fulminating Antimony. *Syn.* PYROPHORUS ANTIMONY, L. *Prep.* Tartar emetic (dried), 100 parts; lampblack or charcoal powder, 3 parts; triturate together, fill a crucible 3-4ths full with the mixture, cover it with a layer of dry charcoal powder, and lute on the cover; after 3 hours' exposure to a strong heat in a reverberatory furnace, and 6 or 7 hours' repose to allow it to cool, cautiously transfer the solid contents of the crucible, as quickly as possible without breaking it, to a wide-mouthed stoppered phial, where, after some time, it will spontaneously crumble down into a powder.

Obs. When the above process is properly con-

ducted, the resulting powder contains potassium, and fulminates violently on contact with water. A piece of the size of a pea introduced into a mass of gunpowder explodes it on being thrown into water, or on its being moistened in any other manner.

Fulminating Bis'muth. *Prep.* From bismuth, 120 parts; carburetted cream of tartar, 60 parts; nitre, 1 part. Very rich in potassium.—*Prop., &c.* Resemble the last.

Fulminating Cop'per. *Syn.* FULMINATE OF COPPER. *Prep.* Digest copper (in powder or fillings) with fulminate of mercury or of silver, and a little water. It forms soluble green crystals that explode with a green flame.

Fulminating Gold. *Prep.* Recently precipitated peroxide of gold is digested in strong liquor of ammonia for 24 hours, and the resulting product is dried in the open air or at a temperature below 180° F., care being taken to avoid the slightest friction, lest it should explode. A deep olive-coloured powder.

Obs. This compound can only be safely made in very small quantities at a time, as without great care it explodes with extreme violence. This is caused by the slightest friction or sudden rise of temperature. Its fulminating property may be destroyed by boiling it in pearlash lye, or weak oil of vitriol; and by heating the residuum after washing it in water, pure gold will be obtained.

Fulminating Mer'cury. *Syn.* FULMINATE OF MERCURY. Mercury, 100 parts; nitric acid (sp. gr. 1·4), 1000 parts (or 740 parts by measure); dissolve by a gentle heat, and when the solution has acquired the temperature of 130° F., slowly pour it through a glass funnel tube into alcohol (sp. gr. ·830), 830 parts (or 1000 parts by measure), as soon as the effervescence is over, and white fumes cease to be evolved, filter through double paper, wash with cold water, and dry by steam (not hotter than 212° F.) or hot water. The fulminate is then to be packed in 100-gr. paper parcels, and these stored in a tight box or corked bottles.—*Prod.*, 130% of the weight of mercury employed.

Prop., &c. Small brownish-grey crystals which sparkle in the sun; entirely soluble in 130 parts of boiling water, and deposited as the solution cools under the form of beautiful pearly spangles. It greatly resembles fulminate of silver in its appearance and general properties. It explodes violently by both friction and percussion, but unlike the silver-salt, merely burns with a sudden and almost noiseless flash when kindled in the open air.

This preparation is used for priming the copper percussion caps for fowling-pieces, muskets, &c. Dr Ure, in his first report to the Board of Ordnance, recommended the use of a spirituous solution of gum-sandarac as the best substance for diluting the fulminate and fixing it in the caps; but in a subsequent report to the same Board, he stated that a solution of mastic in spirit was to be preferred. At the present time the following composition is applied to the interior of percussion caps in quantities varying from ·2 to ·3 of a gr.: Chlorate of potassium, 26 parts; nitre, 30; fulminate of mercury, 12; sulphur, 17; ground glass, 14; gum, 1; making altogether 100 parts (*Watts*).

Caution. Fulminate of mercury should only be dried in small parcels at a time, and these should be placed at a distance from each other. The dreadful explosion which occurred some years ago at the Apothecaries' Hall, and by which Mr Hennel, the talented chemist of the Apothecaries' Company, lost his life, was occasioned by the spontaneous detonation of this substance.

Fulminating Plat'inum. *Syn.* PLATINUM FULMINANS, L. *Prep.* By acting on platinic oxide with pure ammonia. It is analogous to the gold and silver ammonia-compounds.

Fulminating Powder. *Syn.* DETONATING POWDER; PULVIS FULMINANS, L. *Prep.* 1. Nitre, 3 parts; carbonate of potash (dry), 2 parts; flowers of sulphur, 1 part; reduce them separately to fine powder before mixing them. A little of this compound (20 to 30 gr.), slowly heated on a shovel over the fire, first fuses and becomes brown, and then explodes with a deafening report.

2. Sulphur, 1 part; chlorate of potassa, 3 parts. When triturated, with strong pressure, in a marble or wedgewood-ware mortar, it produces a series of loud reports. It also fulminates by percussion.

3. Chlorate of potassa, 6 parts; pure lampblack, 4 parts; sulphur, 1 part. A little placed on a anvil detonates with a loud report when struck with a hammer. No. 1 is the substance commonly known as 'FULMINATING POWDER.' See BLASTING POWDER.

Fulminating Sil'ver. *Syn.* ARGENTUM FULMINANS, L. Two very distinct compounds are known by this name, the one containing oxide of silver and ammonia, and the other being a true fulminate of silver.

Prep. 1. (AMMONIA-COMPOUND OF SILVER, BERTHOLLET'S FULMINATING SILVER.) *a.* Digest oxide of silver (recently precipitated and dried by pressure between bibulous paper) in concentrated liquor of ammonia for 12 or 15 hours, pour off the liquid, and cautiously dry the black powder in the air, in divided portions. The decanted ammoniacal liquor, when gently heated, yields, on cooling small crystals, which possess a still more formidable power of detonation than the black powder, and will scarcely bear touching, even whilst under the liquid.

b. Dissolve chloride of silver in strong liquor of ammonia, cautiously add pure potash (in fragments), and when effervescence ceases, decant the fluid portion, and wash and dry the powder, as before.

2. (FULMINATE OF SILVER, BRUGNATELLI'S FULMINATING SILVER; ARGENTI FULMINAS, L.) *a.* Pour alcohol, 1 oz., on nitrate of silver (in fine powder), 100 gr., previously placed in a capacious flask or beaker glass, and shortly afterwards add strong nitric acid, 1 oz.; as soon as all the powdered nitrate assumes the form of white clouds, add cold distilled water, to suspend the ebullition, and next collect the powder on a filter, and otherwise proceed as with the ammonia-compound (*above*).

b. (*Liebig.*) Grain silver, 1 part; nitric acid (sp. gr. 1·36 to 1·38), 10 parts; dissolve at a gentle heat, and add the solution to alcohol of

85%, 23 parts; apply a gentle heat till the liquid begins to boil, then remove it from the fire and set it aside to cool; the fulminate of silver is deposited in lustrous, snow-white, acicular crystals, and when washed and dried, equals in weight that of the silver employed.

Prop., &c. The properties of both compounds are very similar. Those of the true FULMINATE OF SILVER (No. 2) need only be considered here. This dissolves in 36 parts of boiling water, but the solution deposits the greater portion of the fulminate as it cools. It is one of the most dangerous substances known. It explodes with unparalleled violence by friction or percussion, or when strongly heated, or when touched with strong sulphuric acid; the metal is reduced, and a large volume of gaseous matter suddenly liberated. Strange to say, though its explosive tendency is so great that it can hardly be made, handled, or kept with safety, it may, when very cautiously mixed with oxide of copper, be burned in a tube to determine its composition, in a similar manner to that employed in the analysis of other organic substances. Many frightful accidents have happened from the spontaneous explosion of this substance. 1 or 2 gr. are the most that can be exploded with safety in a building or confined space.

Fulminating Zinc. *Syn.* FULMINATE OF ZINC; ZINCUM FULMINANS, ZINCI FULMINANS, L. *Prep.* From fulminate of silver zinc filings, and a little water, digested together, as FULMINATING COPPER.

FULMINA'TION. *Syn.* FULMINATIO, L. Detonation. A sudden explosion, accompanied by a loud report and extreme violence. Some chemists, without sufficient reason, have endeavoured to confine the application of the term to the explosion of a fulminate.

FUMIGATION. *Syn.* FUMIGATIO, SUFFUMIGATIO, L. Fumigations (FUMIGATIONES) are vapours of gases extemporaneously extricated for the purposes of destroying contagious or noxious miasmata or effluvia, or to mask unpleasant odours, or to produce a medicinal action on those parts of the body with which they are brought in contact.

Fumigations, for the purpose of obviating or masking unpleasant odours in a sick chamber, must never be employed to the neglect of cleanliness and ventilation; for most of them, instead of purifying the air, actually render it less fit for respiration. The common practice of burning scented paper, pastilles, sugar, juniper berries, benzoin, cascarilla, &c., so as to create an odoriferous smoke, is of this character. As disinfecting agents they are probably useless, and are relics of an ancient custom of burning frankincense and other odorous substances in vitiated air to overcome the fœtor which is more or less present. The fumes thus diffused through the atmosphere "disguise unpleasant odours; but they accomplish nothing more. The infection remains not only unaltered by the diffusion of the most powerful aromatic vapours, but its deleterious properties are sometimes augmented by them." We deem it right to remark that a different opinion respecting the disinfecting power of odoriferous smoke is now held by many scientific men. According to this opinion, the minute particles of aromatic substances do really destroy or render inert the noxious miasmata.

Among the various substances used as DISINFECTING FUMIGATIONS, chlorine, by almost general consent, holds the first place. Dr Carmichael Smyth recommended nitrous acid, which is even now preferred by Dr Christison to chlorine; whilst Professor Graham regarded the fumes of burning sulphur as more efficacious than either of these substances. The vapours of hydrochloric acid and of vinegar, and the smoke of gunpowder, which once had their advocates, have now justly sunk into disfavour.

No apartment should be submitted to fumigation until it is vacated; as until then its thorough disinfection is impossible, and but little benefit or immunity from contagion is conferred by any aërial disinfecting agent, the presence of which fails to cause discomfort to the patient.

Of all common diseases, scarlet fever appears to be the one most requiring fumigation. For this purpose, chlorine gas or heat should be employed. The infectious matters of certain diseases, especially scarlet fever, are either dissipated or destroyed at a heat slightly above that of boiling water (*Dr Henry*). Contagious diseases are very commonly propagated in this metropolis by persons having their linen washed by laundresses who perform their operations in the same sinks of dirt and misery in which they live. See CIGARS (in *pharmacy*), DISINFECTANT, INHALATION, &c., and *below*.

Fumigation, Ace'tic. *Syn.* FUMIGATIO ACETICA, L. The fumes of strong vinegar or acetic acid, obtained by heating the liquid over a lamp, or by sprinkling it on a hot shovel. Aromatic vinegar in this way yields very refreshing fumes, and was formerly thought more efficacious than simple acetic acid.

Fumigation, An'odyne. *Syn.* FUMIGATIO ANODYNA, L. *Prep.* (*Trousseau* and *Reveil.*) Stramonium and sage, equal parts, sufficient to fill a small pipe. Smoked in spasmodic asthma, irritating coughs, &c.

Fumigation, Aromat'ic. See BALSAMIC FUMIGATION.

Fumigation, Balsam'ic. *Syn.* AROMATIC FUMIGATION; FUMIGATIO AROMATICA, F. BALSAMICA, L. *Prep.* 1. From gum-benzoin, either alone or mixed with olibanum or styrax, thrown on hot cinders or a heated shovel.

2. (*Dr Dohrn.*) Gum-olibanum, 4 parts; gum-benzoin, styrax, and flowers of roses and lavender, of each, 1 part; to be reduced to powder, and used as before.

3. Amber, mastic, and olibanum, of each, 3 oz.; benzoin and styrax, of each, 1 oz.; camphor, 1 dr. As last. The above are used in hooping-cough, asthma, &c.; a small quantity only being employed at a time.

Fumigation, Belladon'na. *Syn.* FUMIGATIO BELLADONNÆ, L. *Prep.* (*M. Schroeder.*) From dried belladonna leaves, 1 to 2 dr.; as before. In spitting of blood, asthma, tickling cough, &c.

Fumigation, Chlorine. *Syn.* DISINFECTING FUMIGATION, GUYTON-MORVEAU'S F.; FUMIGATIO CHLORINII, L. *Prep.* 1. (P. Cod.) Common salt, 3 parts; water and sulphuric acid, of

each, 2 parts; black oxide of manganese, 1 part; mix in a shallow vessel, placed in the centre of the apartment. This is used to disinfect unoccupied rooms.

2. Hydrochloric acid and powdered black oxide of manganese, mixed in proportions, so as to make a thin paste. Used as directed under No. 1.

3. Chloride of lime, either sprinkled on the floor (if uncarpeted) or (if carpeted) placed about the room in shallow dishes. Used for inhabited rooms, and on shipboard, &c.

4. A solution of chloride of lime (1 oz. of the chloride to each quart of water). Used as the last, but more freely.

Obs. Chlorine fumigations, although so popular, and so much relied on by many medical practitioners, are apparently useless in preventing the progress of certain contagious diseases. "In Moscow, chlorine was extensively tried and found unavailing, nay, even injurious, in cholera" (*Dr Pereira*). "At the time that the cholera hospital was filled with clouds of chlorine, then it was that the greatest number of the attendants were attacked" (*Dr Albers*). At the smallpox hospital, where chlorine was tried, with the view of arresting the progress of erysipelas, "all offensive smell was removed, but the power of communicating the disease remained behind" ('Lond. Med. Gaz.'). Notwithstanding these marked failures, the confidence of many eminent members of the profession continues unabated. "As a fumigating agent, disinfectant, and antiseptic, chlorine, I believe, stands unrivalled." "For destroying miasmata, noxious effluvia, and putrid odours, it is the most powerful agent known" (*Dr Pereira*). Our own experience leads us to the conclusion that chlorine is more useful in neutralising the contagious or morbific matter of fevers (especially of scarlet fever) and putrid diseases generally, than of the other diseases in which it has been employed.

Fumigation, Hydrochlo″ric. *Syn.* Muriatic fumigation; Fumigatio muriatica, F. acidi hydrochlorici, L. *Prep.* From common salt placed in a cup or saucer, and an equal weight of sulphuric acid poured over it. Now seldom used. It rapidly neutralises ammoniacal fumes.

Fumigation, I′odine. *Syn.* Fumigatio iodinii, L. *Prep.* 1. From iodine, 5 to 25 gr., or more, according to extent of surface, placed on a heated iron contained in a box or case in which the limb is enclosed. In the usual skin diseases in which the use of iodine is indicated, iodine may be readily diffused through the atmosphere by placing a small quantity on a hot plate. Duroy says iodine powerfully arrests putrefaction.

2. (Compound: Fumigatio iodinii composita, *Sellers.*) Iodine, 20 gr.; red sulphide of mercury, 40 gr.; sulphur, 6 dr.; mix, and divide into 12 powders. 1 to be used, as the last, 3 times daily; in lepra, psoriasis, &c.

Fumigation, Mercu″rial. *Syn.* Fumigatio mercurialis, L. *Prep.* (*Bouchardat.*) Olibanum (in powder), 2 parts; red sulphide of mercury, 3 parts. A little is sprinkled on red-hot coals or a heated shovel held beneath the part; or the fumes are inhaled.

Obs. Abernethy used the black oxide of mercury (1½ to 2 dr.), and applied it to the whole body, excepting the head, in a similar way to the sulphur-bath, and continued the application for about a ¼ of an hour. See Candles (Mercurial), and No. 2 (*above*).

Fumigation, Muriat′ic. See Hydrochloric F. (*above*).

Fumigation, Ni′trous. *Syn.* Fumigatio nitrosa. *Prep.* (P. Cod.) Sulphuric acid, diluted with half its weight of water, is placed in a porcelain cup (any shallow vessel of glass or earthenware will do), placed over heated cinders, and small quantities of powdered nitre added to it from time to time.

Obs. Heat causes the gas to be evolved more rapidly, and thus renders the fumes more offensive without increasing their efficacy. Equal weights of oil of vitriol and water are the proportions usually employed, ¼ oz. of nitre is said to be sufficient for a small room (*Dr Bateman*). The vessel containing the ingredients should be placed in an elevated position in the centre of the apartment.

Dr Carmichael Smith, who introduced nitrous acid gas as a fumigation (1799), received a reward of £5000 from Parliament for publishing his formula.

Fumigating Paper. Anti-asthmatic paper. (Codex.) Unsized paper, 120 grms.; powdered nitrate of potash, 60 grms.; powdered belladonna, stramonium, digitalis lobelia inflata, and phellandrium, of each, 5 grms.; myrrh and olibanum, of each, 10 grms. Mix the powders and incorporate them with the paper previously soaked in water. Spread the mass evenly on tinned-iron plates, press in a mill and dry in hot air. When quite dry divide into 36 rectangular pieces.

Fumigation, Sul′phurous. *Syn.* Fumigatio sulphurosa, F. sulphuris, L. *Prep.* 1. The gas produced by burning sulphur, sulphurous anhydride, or, as Mr Keates has suggested, by burning bisulphide of carbon.

To guard against the danger arising from fire, when sulphur is burnt for the purposes of fumigation the operator is advised to proceed as follows:—Having closed the fireplace, windows, &c., of the apartment to be disinfected, procure a common pail, or a large earthenware pan, and place it in the centre of the room; then into the middle of the pail or pan put upside down an ordinary flower-pot. Then pour water into the pail or pan (as the case may be) until it nearly reaches to the top of the inverted flower-pot. Now stand on the flower-pot a plate or saucer of earthenware or common crockery, sufficiently large to hold the quantity of sulphur required; place this quantity of sulphur in the plate or saucer, and put on it a few live coals; then close the door of the apartment, and leave it undisturbed for 6 or 8 hours. At the expiration of this time the door may be opened, as well as the windows, the barricade being at the same time removed from the fireplace; a thorough draught of air being thus established, the sulphurous smell will soon disappear. During the fumigation all articles within the room should be spread out so as to expose as great a surface as possible. "The cubic space to be thus disinfected should be calculated by multiplying the length, height, and breadth together, and taking 1½ oz. of sulphur for every

100 cubic feet. For a small bedroom 1 lb. of sulphur would be sufficient. Indeed, 18 oz. would suffice for a room measuring 12 ft. × 10 ft. × 10 ft." ('Water, Air, and Disinfectants,' by Noel Hartley).

2. Flowers of sulphur, 7 parts; nitre, 4 parts; benzoin and olibanum, of each, 2 parts; camphor, 1 part; pressed into the bowls of tobacco-pipes, and lighted with a quick-match. See BATH and DISINFECTANT.

Fumigation, Tar. *Syn.* FUMIGATIO PICEA, SUFFUMIGATIO PICIS LIQUIDÆ, L. *Prep.* 1. Vegetable tar, 1 part; water, 7 or 8 parts; mix, and let it simmer in an open vessel set over a spirit-lamp placed near the centre of the apartment.

2. (*Sir A. Crichton.*) Norway tar, 1 lb.; powdered carbonate of potash, ½ or 1 oz.; mix, and heat it as last. The potash is added to neutralise any volatile acid. Formerly highly thought of in bronchitis and pulmonary consumption.

Fumigation, Tooth'ache. *Syn.* FUMIGATIO ODONTALGICA, F. ANTINEURALGICA, L. *Prep.* 1. From henbane seeds, powdered and thrown into a basin of boiling water, and the affected part held in the steam. Sometimes a little of the seed is place on a heated iron spoon, and the part exposed to the fumes.

2. (*Beasley.*) A popular remedy is to throw henbane seed on hot cinders, inverting a cup over them to receive the smoke and empyreumatic oil produced. The cup is then filled with hot water, and the steam conveyed to the affected side of the mouth.

FU"MING LIQUORS. See AMMONIUM SULPHYDRATE, ARSENIC TRICHLORIDE, TIN BICHLORIDE, &c.

FUNG'I. In *botany*, a natural order of cellular plants, producing their fructification in the air; growing in or upon decaying or living organic substances, and nourished through their vegetative structure called the spawn or mycelium. Fungi have very variable properties. Some are medical, others edible, others are deadly poisons. The various diseases of plants known as blight, mildew, rust, smut, vine-mildew, potato-disease, ergot, &c., are either caused by or accelerated by the agency of fungi. See AGARIC, MUSHROOM, &c.

FUR'NACE. An enclosed fireplace for obtaining a high degree of heat. Furnaces vary much in construction and size, according to the particular manufacture in which they are employed. They may be broadly divided into two classes—WIND-FURNACES and BLAST-FURNACES. In the former a high temperature is produced without the aid of bellows by means of a powerful draught. In the latter heated air is blown in through a pipe or pipes at the bottom. For many metallurgic and large chemical operations REVERBERATORY FURNACES are employed. A furnace of this kind is usually long, with a low roof to keep down the flame and hot air upon the 'hearth' or space between the fireplace and the flue. For an illustration of this kind of furnace, see SODIUM (Carbonate of.) For the smaller operations in *chemistry*, a variety of furnaces have been invented, and the introduction of coal gas as a fuel by Deville, Griffin, Gore, Fletcher, and others, has wrought a complete change in the arrangements of the *laboratory*. The GAS-FURNACES of Mr J. J. Griffin are adapted for almost every operation performed by the aid of heat. Those more recently introduced by Mr W. Gore are very compact and portable, and will rapidly produce a 'white heat,' without the help of bellows or high chimney, by means of ordinary coal gas and atmospheric air. The first and smallest size consumes 33 cubic ft. of gas (value 7 farthings) per hour, and is suitable for assayers, jewellers, analytical chemists, experimentalists, dentists, and others. It is capable of fusing 8 oz. of copper or 6 oz. of cast iron; copper begins to melt in it in about 12 minutes from the time of lighting. The second-sized one consumes about twice that quantity of gas, is suitable for manufacturing jewellers generally, and for a great variety of practical persons who require to melt small quantities of gold, silver, copper, German silver, brass, cast iron, glass, and other substances, or require a small crucible heated to high temperatures. It is capable of melting 45 oz. of copper, or 40 oz. of cast iron, and with its heat up it melts 1 lb. of copper in 8 minutes; copper begins to melt in about 20 minutes from the time of lighting.

Fletcher's (manufactured by Thos. Fletcher, Museum Street, Warrington) UNIVERSAL FURNACES for high temperatures, which are said to require neither blast nor attention, are intended for laboratory purposes, enamel burning, heating soldering irons, and for jewellers' and dentists' work. These furnaces are made in two distinct types; one with a perforated cover to the crucibles and muffles to attain the maximum heat; the other with a slide chimney and a double lid over the crucible.

The power and rapidity of working depend in each case on the length of the chimney used. A furnace with a 4 ft. chimney will melt a crucible of cast-iron in 35 minutes; a furnace with an 8 ft. chimney will melt the same quantity of iron in about 20 minutes, starting with the furnace cold. The stove with the side chimney, although more convenient in use, is slower in working, taking about twice as long to obtain the same temperature.

The following are varieties of Fletcher's UNIVERSAL FURNACE:

1. SMALL LABORATORY FURNACE for crucibles, with nickel-plated burner tubes. This takes crucibles up to 2½ in. by 2¼ in. outside, and with a 3 ft. chimney, as supplied with the furnace, will, it is stated, melt copper, gold, silver, &c., in about 10 minutes, or cast iron in 35 minutes from the time the gas is lighted. Small muffle fittings, with muffles 2¼ in. by 3 in. by 2½ in. inside, can be supplied with this furnace.

2. SMALL CRUCIBLE FURNACE, with fixed chimney. This furnace is more especially designed for gold, silver, copper, &c., and as sent out with a 4 ft. chimney and a single lid, is amply powerful, and practically of a very convenient form.

3. SMALL MUFFLE FURNACE, with 3 ft. chimney. This requires about 18 in. longer chimney than the small crucible furnace to obtain the same temperature in the same time,

owing to a slight loss of heat by radiation from the stoppers.

4. *a.* LARGE MUFFLE FURNACE. This is identical in design and construction with the smaller one. The clear working space inside the muzzle is $3\frac{7}{8}$ in. by 5 in., by about 3 in. deep. This is recommended as a useful furnace for watch-dial enamellers, assayers, photo-enamel burning, and for all purposes where exact temperatures are required not exceeding the fusing point of cast iron.

The burner of this furnace is twice the size of the small laboratory furnace, and requires a gas supply from a pipe and tap of $\frac{1}{2}$-in. bore. The burner is the same shape as the muffle, and is unfit for crucible work.

b. EXTRA LARGE MUFFLE FURNACE, $4\frac{1}{2}$ in. by $3\frac{3}{4}$ in. by 7 in. clear inside working space. This will take a No. 3 plumbago pot, and with $\frac{1}{2}$-in. gas pipe, giving a supply of about 35 ft. per hour, will, it is affirmed, melt 3 or 4 lbs. of brass in about 25 minutes, and the same quantity of cast iron in 60 or 70 minutes from the time the gas is first lighted, without the slightest trouble or attention.

5. LADLE FURNACE. This takes ladles up to $6\frac{1}{2}$ in. diameter, and will melt 6 or 8 lbs. of zinc in about 15 minutes, or the same quantity of lead, tin, &c., in about half the time. It is said to be a convenient and powerful arrangement for dentists, heating soldering-irons, making granulated zinc, sand-baths, &c.

6. SMALL LABORATORY FURNACE, complete for crucibles, muffles, ladles, and sand-baths.

7. FLETCHER'S INJECTOR GAS FURNACE (with blast). This furnace is intended for general purposes, and for the treatment of refractory substances at high temperatures. The patentee states "that it will burn perfectly in the same space any available gas supply from 10 ft. to 50 ft. per hour, or more if required, giving temperatures in exact proportion; and any operation may be repeated at any time by taking a note of the position of the air slide which governs the combustion of the gas."

Mr Fletcher gives the power of the small furnace as follows:—With a $\frac{1}{2}$-in. gas supply-pipe, day pressure, starting with the furnace cold, it will melt silver in 3 minutes, cast iron in 8 minutes, cast steel in 25 minutes.

With a supply of 50 ft. per hour, the same results are stated to be obtained in a little over half the time, and so on in proportion with a greater or less gas supply. It is also said to work satisfactorily for gold, &c., melting it with a supply of gas too small for any other furnace, and the maximum temperatures obtained are limited, only by the available gas supply and the fusibility of the casing. The highest temperature, as obtained by measuring by Wedgwood's pyrometer, is said to be 9000° F. This furnace is stated to be particularly suited for gold and silver melting and refining, iron assays, and general crucible work, and safe in the hands of the most careless workman. It is adapted for crucibles not exceeding 4 in. by $2\frac{1}{4}$ in., 5 in. by $3\frac{1}{2}$ in., $7\frac{1}{2}$ in. by 5. For further information respecting furnaces intended for use in the laboratory and assay office, the reader is referred to 'Watt's Dictionary of Chemistry;' also to 'Ure's Dictionary of Arts, Manufactures, and Mines,' for description of the furnaces employed in the different metallurgical operations; and to the 'Chemical News' (June 30th, 1876, and February 2nd, 1877), for a description of a new decomposing furnace. See ASSAYING, CHIMNEYS, COPPER, CRUCIBLE, FUEL, &c.

FUR'NITURE. See FRENCH POLISHING, OIL, POLISH, VARNISH, &c.

FURS. Of these the most valuable are ermine and sable. Fur skins, when unprepared, or merely dyed, go under the name of 'peltry' (*Brande*).

Furs may be preserved from moths and other insects by placing a little colocynth pulp (bitter apple), or spice (cloves, pimento, &c.), wrapped in muslin, among them; or they may be washed in a very weak solution of corrosive sublimate in warm water (10 to 15 gr. to the pint), and afterwards carefully dried. As well as every other species of clothing, they should be kept in a clean, dry place, from which they should be taken out occasionally, well beaten, and exposed to the air, and re-turned.

FURSTENBALSAM, Bamberger für Frauen. BAMBERG PRINCE'S BALSAM FOR WOMEN. An embrocation for strengthening women after confinement. A hexagonal eau de Cologne bottle containing about 100 grms. of a clear reddish-brown fluid, which is a filtered mixture of equal parts of spirit of lavender (Sp. Lavand. Co.) and spirit of soap, mixed with a little camphor and ammonia (*Hager*).

FU'SEL OIL. *Syn.* FOUSEL OIL, POTATO OIL, OIL OF POTATO SPIRIT, GRAIN OIL, GRAIN SPIRIT OIL, MARC-BRANDY OIL. *Source.* An offensive strong-smelling oil, produced along with alcohol during the fermentation of grain, potatoes, &c., on the large scale, and which gives the peculiar and disagreeable flavour and odour to raw whisky. It is found chiefly in the last portion of the spirit which passes over, called the 'faints,' to which it imparts its characteristic odour and flavour. By rectifying the faints at a very gentle heat most of the alcohol and water first pass over together with only a little fusel oil, whilst the latter forms the residuum in the still. Various names (as *above*) are given to the crude oil thus obtained, according to its source. It consists of higher homologues of ordinary ethyl alcohol, viz. propyl, butyl, and amyl alcohols, and of fatty acids and ethereal salts. The oil of potato-spirit is the purest form of crude fusel oil.

Obs. The exertions of the distiller are directed, as much as possible, to lessen the formation of fusel oil during the fermentation of his 'worts,' and to eliminate, during the distillation and rectification of his liquors, the greatest possible proportion of that with which they may be contaminated.

Prop., &c. Fusel oil is a nearly colourless volatile liquid, with a rather high boiling-point a durable, penetrating, offensive smell, and an acrid, burning taste; when swallowed it occasions nausea, giddiness, headache, &c.; in slightly larger quantities, vomiting, delirium, oppressive respiration, and lessened sensibility to pain; its vapour also produces these effects. In quantity it

is a narcotic poison. The greater intoxicating power of whisky, more especially that from raw grain than other spirit, is due to the larger quantity of fusel oil which it contains. This appears to be well known to the lower class of whisky drinkers in these islands, and to the consumers of corn-brandy in some of the northern parts of Europe. The last are said to frequently demand to be served with "a glass of good fusel." In England fusel oil is chiefly used for lamps and varnishes.

Amyl alcohol may be prepared from fusel oil in the following manner:—Introduce the ordinary fusel oil of the distilleries into a small still or retort, connected with a condenser, and apply heat; as soon as the oil begins to flow over, unmixed with water, change the receiver, resume the distillation, and carry it nearly to dryness; the product in the second receiver, and the oily matter which separates from the water in the first receiver, are to be reserved for use. It is employed in the preparation of VALERIANATE OF SODA. See AMYL.

FU'SIBLE ALLOY. *Syn.* FUSIBLE METAL. *Prep.* 1. Bismuth, 2 parts; lead, 5 parts; tin, 3 parts. Melts in boiling water.

2. (*D'Arcet's.*) Bismuth, 8 parts; lead, 5 parts; tin, 3 parts. Melts below 212° F.

3. (*Walker.*) Bismuth, 8 parts; tin, 4 parts; lead, 5 parts; antimony, 1 part. The metals should be repeatedly melted and poured into drops, until they are well mixed.

4. (*Onion's.*) Lead, 3 parts; tin, 2 parts; bismuth, 5 parts. Melts at 197° F.

5. To the last, after removing it from the fire, add of quicksilver (warm), 1 part. Liquid at 172°, solid at 140° F.

The composition of some other varieties of fusible metal is given under BISMUTH.

Obs. The first four of the above are used to make TOY SPOONS, to surprise children by their melting in hot liquors. A little mercury may be added to lower their melting-points. Nos. 2 and 3 are specially adapted for making ELECTROTYPE MOULDS. The beautiful casts of the French medals known to all electrotypers as Clichée moulds are in the alloy No. 3. The above alloys are also used to form PENCILS for writing on asses' skin, or paper prepared by rubbing burnt hartshorn into it, &c.; also as a METAL BATH in the *laboratory*. The last is used for ANATOMICAL INJECTIONS.

FU'SION. *Syn.* FUSIO, L. The liquefaction of solid bodies by the action of heat. The term AQUEOUS FUSION has been applied to the melting of salts in their combined water when heated; and the term IGNEOUS FUSION to the liquefaction of bodies by heat alone.

The temperature at which a substance fuses or melts is termed its MELTING-POINT, and is of great importance in organic chemistry, for organic compounds are identified to a great extent by means of their melting-points; and further, the purity of a substance may be ascertained by its having a definite melting-point, while impure substances do not melt quickly and definitely, but only slowly as the temperature rises. The melting-point of a substance is determined by placing a small quantity of it in the closed end of a thin-walled capillary tube sealed at one end, which is attached by a small india-rubber ring to the stem of a thermometer, so that the bulb of the latter is in close proximity to the part of the tube containing the substance. The whole is then placed in a bath of some transparent liquid, such as water, melted paraffin, or sulphuric acid, according to the temperature required, care being taken that the open end of the capillary tube remains well above the surface of the liquid. The bath is then heated, and, as the temperature rises, the exact point at which the substance melts is read off on the thermometer.

FUS'TIC. *Syn.* FUSTIC WOOD. Two distinct dye-stuffs are known by this name, but are distinguished by the adjectives 'old' and 'young.'

Fustic, Old. *Syn.* BOIS JAUNE, Fr. The wood of the *Maclura tinctoria.* Its decoction dyes woollens yellow of different shades, according to the 'mordant.' Alum, tartar, and spirits of tin brighten the tint; acetate and sulphate of iron and common salt darken it; with sulphate of iron, it gives olives and browns; with the indigo vat and sulphate of indigo, green. These colours are very permanent. Its yellow turns on the lemon when pale, and on the orange when darker. 1 lb. of old fustic will dye 3 to 5 lbs. of wool.

Fustic, Young. *Syn.* YELLOW FUSTIC; FUSTET, Fr. The wood of the *Rhus cotinus* or Venice sumach. It gives a yellow turning on the green, but its colours are not very permanent. It is chiefly used in combination with other dye-stuffs.

GAL'BANUM. *Syn.* GUM-GALBANUM; GALBANUM (B. P.), L. "A gum-resin derived from an umbelliferous plant, *Ferula galbaniflua.* In irregular tears about the size of a pea, usually agglutinated into masses; of a greenish-yellow colour, translucent, having a strong disagreeable odour and an acrid bitter taste" (B. P.). Its properties are similar to the other fœtid antispasmodic gum-resins. It ranks between ASSAFŒTIDA and AMMONIACUM.

Galbanum, Strained. *Syn.* PREPARED GALBANUM; GALBANUM COLATUM, G. PRÆPARATUM (Ph. L.), L. From crude galbanum, as PREPARED AMMONIACUM. Formerly the common practice was to melt it in the dry state, by heat cautiously and quickly applied, and to strain it through a piece of coarse canvas stretched across a wooden frame or 'horse.' The 'strained galbanum' of the shops is seldom pure. The following forms are current in the trade for its 'reduction,' as this species of adulteration is technically termed:

1. Galbanum (true), 9 lbs.; strain as above; then add, towards the end black resin (clean), 3 lbs.; and when the whole is melted, further add of Venice turpentine, 2 lbs.—*Prod.*, 12 lbs.

2. Strained galbanum and black resin, of each, 6 lbs.; melt, and add of strained assafœtida, 2 oz.; Venice turpentine, 3 lbs.—*Prod.*, 14½ lbs.

Galbanum, Strained (Facti''tious). *Syn.* GALBANUM COLATUM FACTITIUM, L. *Prep.* 1. From black resin, 4 lbs.; melt, and add of Venice turpentine, 2 lbs.; assafœtida, 2½ oz.; oils of juniper and fennel, of each, 1½ dr.; water, ½ pint.

2. As the last, adding soft soap, 5 oz. Some-

times the small and 'waste' of the chests are added to the above to improve them.

GALENA. *Syn.* Black Jack, Lead sulphide. The chief ore of lead. It contains 86·57% of lead, and 13·43% of sulphur. It often contains small quantities of silver.

Prop. It has a lead-grey colour and a strong metallic lustre, crystallises in cubes, is brittle, and has a sp. gr. 7·75. When finely ground it is called alquifoux, and is employed for the manufacture of Pattinson's white-lead, for glazing coarse pottery-ware, and for ornamental purposes.

GALL. *Syn.* Bile; Bilis, Chole, Fel, L. Crude ox-gall is extensively employed by the scourers of woollen cloth, clothes renovators, &c. It rapidly extracts grease and oil from textile fabrics without injuring the colour. See Bile, Constipation, Dyspepsia, Ox-gall, &c.

Gall, Glass. See Saniver.

GAL'LATE. *Syn.* Gallas, L. A salt of gallic acid. The alkaline gallates are soluble. They rapidly suffer decomposition in the presence of excess of the base, and the liquor gradually acquires a blackish colour. The gallates of most of the other metallic oxides are insoluble.

GAL'LIC ACID. $H_3C_7H_3O_5$.Aq. *Syn.* Acidum gallicum (B. P.), L.; Trihydroxy-benzoic acid. Occurs in the free state in gall-nuts, tea, divi-divi, mangoes, and other plants; and in combination as a glucoside in some tannic acids.

Prep. 1. (*Dumas.*) Nut-galls, reduced to powder, are moistened with water and exposed to the action of the air in a warm situation (say 70°—80° F.) for 2 or 3 months, adding more water from time to time, to make up for that lost by evaporation. At the end of the above period the mouldy, dark-coloured mass is strongly pressed in a cloth, and the solid portion boiled in a considerable quantity of water. The solution (filtered whilst hot) deposits, on cooling, crystals of gallic acid, which, after being thoroughly drained and pressed dry between bibulous paper, are purified by boiling them along with about $\frac{1}{6}$ of their weight of prepared animal charcoal in 8 parts of water, and filtering, &c., as before.

2. (*Graham.*) A strong infusion or decoction of galls is precipitated with sulphuric acid in the cold; the resulting thick mass is mixed with dilute sulphuric acid (cold), and the liquid expressed; the 'marc' is next treated with sulphuric acid diluted with twice its weight of water, and after boiling the mixture for some minutes the whole is allowed to cool; the resulting crystals are purified as before.

3. (*Liebig.*) A strong aqueous solution of tannic acid (tannin) is added to sulphuric acid as long as a precipitate falls; the powder is collected, washed, and dissolved by the aid of heat in dilute sulphuric acid; the solution, after being boiled for a few minutes, deposits, on cooling, crystals of gallic acid in considerable quantity.

It may be prepared artificially by heating di-iodo-salicylic acid with potassium carbonate, or by fusing brom-proto-catechuic acid with potash.

Prop. Gallic acid forms small, feathery, and nearly colourless crystals, which have a beautiful silky lustre; that of commerce is usually of a pale-yellow colour; it is soluble in 100 parts of cold water, and in 3 parts of boiling water; it is also soluble in alcohol, and slightly so in ether; the aqueous solution is decomposed by exposure to the air; dissolved in hot oil of vitriol, it forms a deep, rich red solution, which, when thrown into water, throws down the gallic acid, deprived of some of its water. This substance is soluble in the alkalies, and dyes cloth like madder. When strongly heated, gallic acid evolves carbon dioxide, and is converted into pyrogallic acid.

Tests. Gallic acid is distinguished from tannic acid by not affecting solutions of gelatin, the protosalts of iron, or the salts of the alkaloids, and by giving a deep bluish-black precipitate with the sesquisalts of iron, which disappears when the liquid is heated. It is distinguished from pyrogallic acid by its inferior insolubility in water, and by its not affecting the solutions of the protosalts of iron. To detect gallic acid mixed with tannic acid, the latter should be removed, either by digesting the substance in ether, or by precipitating it with gelatin previously to applying the tests.

Uses, &c. The principal use of pure gallic acid is in the art of *photography.* It is employed in *medicine,* as an internal astringent, in doses of 3 to 10 gr., thrice a day, or oftener; in hæmorrhage and fluxes, as well as for checking the night sweats in phthisis. In all cases of internal hæmorrhage or hæmorrhagic tendency, it is the best astringent or styptic we possess. As an external astringent, it is greatly inferior to tannic acid.

Purification. Gallic acid, as obtained by either of the above forms, is never quite pure; but it may be rendered absolutely pure by combining it with oxide of lead, and decomposing the compound (gallate of lead) by sulphuretted hydrogen. Commercial gallic acid may be rendered nearly white by dissolving in 20 times its weight of boiling distilled water, and filtering the solution through a stratum of prepared animal charcoal spread upon a calico filter. When the liquid passes through colourless it should be evaporated to 1-6th its volume, and then suffered to cool, in order to effect the separation of the crystallised acid (Ph. D.).

GALLIC FERMENTATION. This name has been given to the peculiar process by which tannic acid is converted into gallic acid, under the joint influence of moisture and atmospheric oxygen. According to the researches of M. Antoine Larocque, the peculiar ferment of nut-galls which effects this change also converts sugar into alcohol and carbonic acid in the same way as yeast does; whilst beer-yeast, muscular flesh, and caseous matter change tannin into gallic acid. The similarity of the gallic and vinous fermentation may hence be reasonably inferred.

GALLIUM. A new metal discovered in August, 1875, by means of the spectroscope, by M. Lecoq de Boisbaudran, in a specimen of blende from the mines of Pierrefitte, in the Pyrenees. The new element was named gallium in honour of France, the discoverer's native country.

Gallium gives a spectrum composed of two bands in the violet, one of the bands being brilliant, and of wave-length 417, and the other a feeble one of wave-length 403·3.

The Pierrefitte blend contains 1 part of gallium in 400,000. It is, however, found much more abundantly in a black blend from Bensberg, on the Rhine, 100,000 parts of this latter yielding 1 part of gallium.

Gallium resembles lead in appearance, but is less blue in colour. Exposed to moist air it tarnishes slightly. It is a little harder than lead, is flexible, malleable, and may be easily cut with a knife. If melted and poured upon glass, it adheres to it, and forms a mirror which is whiter than that caused by mercury. A red heat fails to volatilise it to any appreciable extent, and it is only slightly oxidised at that temperature; therefore it is not tarnished when exposed to the air. Hot nitric acid dissolves it, but the cold acid has scarcely any action on it. It melts at 30·15 C. When once fused, it preserves the liquid condition even for several months at 0° C., until it is touched by some solid body, or by a piece of solid gallium, when it congeals to a crystalline solid, having a specific gravity of 5·93; when fused it has a specific gravity of 6·08. It crystallises in square octahedra. In properties gallium is more or less intermediate between the metals aluminium and iridium.

Chemical Reactions of Gallium. The following are the chief reactions of the salts of gallium when in solution. With ammonia they give a white gelatinous precipitate, soluble but not readily in excess of the precipitant; potash gives a similar precipitate, soluble in excess; acetate of ammonia on boiling in a solution free from excess of acid, precipitates a basic compound; barium carbonate readily precipitates gallium salts in the cold. A sulphate and a chloride of gallium have been obtained. These salts are both very soluble; the sulphate is a non-deliquescent substance, the chloride, on the contrary, is excessively so, and decomposed by a large excess of water. Gallium also forms an alum consisting of the double sulphate with ammonium. Gallium alum is a beautifully crystalline body more soluble in cold than in hot water.

The existence of such a metal as gallium was predicted by Mendelejeff, under the name eka-aluminium (*see* 'Periodic Law').

GALLS. *Syn.* Gall-nuts, Nut-galls; Galla (B. P.); Gallæ (Ph. E.). "Excrescences on *Quercus infectoria* caused by the puncture and deposited ova of *Diplolepis gallæ tinctoriæ.*" The best galls are bluish-black, heavy, and not yet perforated; intensely astringent. They are imported from Aleppo, and are known in *commerce* as black or blue galls (gallæ nigræ, g. cœrulæ). The next quality is termed, from their colour, green galls (gallæ virides). Both are gathered before the insect has escaped, and are styptic and powerfully astringent. White galls (gallæ albæ) are lighter, less astringent, and inferior.

Uses, &c. Galls are extensively employed in the art of dyeing, and constitute one of the pricipal ingredients in all shades of black, and are also employed to fix or improve several other colours. A decoction of galls, to which a little green copperas and gum-arabic has been added, forms common writing ink. In *medicine,* they are used as an astringent, in hæmorrhages and fluxes, in doses of 10 to 20 gr.; and topically, under the form of infusion or decoction, as a gargle in relaxation of the uvula; as an injection in gleet and leucorrhœa; as a lotion or fomenta- in flabby ulcers, prolapsus ani, &c.; and as an ointment in piles, watery ulcers, &c. The infusion or decoction is also used as an antidote to poisoning by the alkaloids, and was formerly given as a tonic in intermittents. See Gallic Acid, Ink, &c.

Galls, Chinese. Woo-pei-tzse. Produced on *Rhus semialata,* Murray. Imported from China and Japan for dyeing purposes.

GALL'STONE. *Syn.* Calculus biliosus, C. cysticus bovinus, L. Formed in the gall-bladder of neat cattle in winter, when they are fed upon dry food. Used as a yellow pigment, and in medicine.—*Dose,* 1 grain; in dyspepsia and flatulency. Man is also subject to gall-stone, the presence or passage of which is attended with the most acute pain, frequently accompanied with nausea and sickness. In no case should a patient suffering from a paroxysm such as above described delay to seek immediate medical aid. The following treatment is recommended for the benefit of those only who, like emigrants and others, may be unable to obtain professional assistance.

The pain and spasm should be endeavoured to be alleviated by full doses of laudanum, given in soda water. If there be much sickness, the laudanum should be given in the form of an enema. Ice applied freely to the pit of the stomach has sometimes been found to give relief. Hot fomentations are exceedingly useful, and should be continued energetically. See Calculus.

GALV'ANIZED IRON. See Iron and Zincing.

GAM'BOGE. *Syn.* Camboge; Cambogia (B. P.), Gambogia, L. "A gum-resin obtained from *Garcinia hauburii*" (B. P.). Gamboge is an active hydragogue and drastic purgative, which occasionally proves useful in torpor of the abdominal and pelvic viscera; but which is highly dangerous in an irritable or inflammatory state of the stomach or bowels, and during pregnancy. It is very apt to induce nausea and vomiting. In large quantities it is a violent poison. "The deaths which have occurred from the use of enormous quantities of Morrison's pills are mainly ascribable to the gamboge contained in those medicines" (*Pereira*).—*Dose,* 1 to 5 gr. made into pills or mixture, every 4 to 6 hours; in obstinate constipation, in dropsies, in apoplexy, and like cerebral affections, and in worms (especially tapeworm), either alone or combined with other cathartics. See Compound Extract of Colocynth.

GAME. The flesh of game is believed to possess strengthening qualities superior to that of poultry. It also contains less fat. Game is tender and easy of digestion, and it has a delicate and marked flavour. It forms a valuable diet for the invalid, by reason of its easy digestibility.

Respecting the choice and preservation of game, Eliza Acton writes—"Buck vension, which is in season from June to Michaelmas, is considered finer than doe venison, which comes into the market in October, and remains in season through November and December; neither should be cooked at any other part of the year.

"The greater the depth of fat upon the haunch

the better the quality of the meat will be, provided it be clear and white, and the lean of a dark hue.

"If the cleft of the hoof, which is always left on the joint, be small and smooth, the animal is young; but it is old when the marks are the reverse of these. Venison is not in perfection when young. Although the haunch is the prime and favourite joint of venison, the neck and shoulder are also excellent, dressed in various ways, and make much approved *pasties*. A free current of air in a larder where venison is kept is always a great advantage.

"All moisture should be wiped daily, or even more frequently, from the venison with soft cloths, when any appears upon the surface, and every precaution must be taken to keep off the flies when the venison is not hung in a wire safe. Black pepper thickly powdered on it will generally answer the purpose.

"Hares and rabbits are stiff when freshly killed, and if young the ears tear easily, and the claws are smooth and sharp. A hare in cold weather will remain good for 10 or 14 days; care only must be taken to prevent the inside from becoming musty, which it will do if it has been emptied in the field. Pheasants, partridges, and other game, may be chosen by nearly the same tests as poultry—by opening the bill the staleness will be detected easily if they have been kept too long by the hardness of the bill. With few exceptions game depends almost entirely for the fine flavour and tenderness of its flesh, on the time which it is allowed to hang before it is cooked, and it is never good when very fresh; but it does not follow that it should be sent to table in a really offensive state."

GAN″GRENE. See MORTIFICATION.

GAN′TEINE. A composition used to clean kid and other leather gloves.

Prep. 1. (*M. Buhan.*) Curd soap (in small shavings), 1 part; water, 3 parts; mix with heat, and stir in of essence of citron, 1 part.

2. (SAPONINE, *Duvignau.*) Soap (in powder), 250 parts; water, 155 parts; disssolve with heat, cool, and add, of *eau de javelle*, 165 parts; solution of ammonia, 10 parts, and rub the whole to a smooth paste. Patent. A small portion of either of the above is rubbed over the glove with a piece of flannel (always in one direction), until it is sufficiently clean. See GLOVES.

GARAN′CINE. See MADDER RED.

GAR′GLE. *Syn.* GARGARISM, THROAT-WASH; GARGARISMA, GARGARISMUS, GARGARISMUM, L. A liquid medicine applied to the back part of the mouth or upper part of the throat. Gargles are applied by allowing a small mouthful to run as much as possible over the affected part, by holding the head backwards and breathing through it, by which means the liquid is agitated and its action promoted.

Gargles are not to be swallowed. It often happens, however, that patients, either by accident or from negligence, do swallow a certain quantity, notwithstanding the instructions given them to the contrary. Care should therefore be taken to avoid making gargles of such substances as may occasion unpleasant symptoms in small doses, though they may not, perhaps, amount to poisoning.

Gargles usually have for their basis either simple water, or milk, wine, or vinegar, diluted with water, to which, in both cases, sugar, honey, or syrup is generally added. Their other ingredients vary with the indication, but must, in all cases, be either in the liquid form, or soluble in the liquid used as the excipient.

Gargles are commonly dispensed in mixture-bottles. The quantity used at a time, under ordinary circumstances, may be about 2-3rds of a wine-glassful.

Gargle. *Syn.* GARGARISMA, G. COMMUNE, G. SIMPLEX, L. *Prep.* 1. (St B. Hosp.) Honey or honey of roses, 1½ fl. oz.; strong vinegar, 2½ fl. oz.; barley water, 1 pint.

2. (St George's.) Oxymel, 1 fl. dr.; decoction of barley, 5 fl. dr. In common sore throats, &c. The formulæ of several other hospitals are similar.

Gargle of Ac′etate of Ammo″nia. *Syn.* GARGARISMA AMMONIÆ ACETATIS, L. *Prep.* (*Wendt.*) Solution of acetate of ammonia and honey of roses, of each, 1 fl. oz.; elder-flower water, 8 fl. oz.; mix. In the ulcerated sore throat of scarlet fever.

Gargle of Acetate of Manganese. *Syn.* GARGARISMA MANGANESII ACETATIS. *Prep.* Acetate of manganese. 1 dr.; water, 7 fl. oz.; clarified honey, 1 oz. (The chloride and sulphate of manganese are also used, about ½ dr. or 2 scruples to 6 oz. of barley water).

Gargle of Ace′tic Acid. *Syn.* OXYMEL GARGLE; GARGARISMA ACIDI ACETICI, L. *Prep.* 1. (St B. Hosp.) Acetic acid, 1 dr.; oxymel, 2 fl. dr.; water to make up 4 fl. oz.

2. Barley water, 12 fl. oz.; acetic acid, 1½ fl. oz.; honey, 6 dr. Antiseptic. For sore throat.

Gargle of Al′um. *Syn.* GARGARISMA ALUMINIS, L. *Prep.* 1. (*Augustin.*) Oak-bark (in powder), 1 oz.; water, 1½ pints; boil to a pint, filter, cool, and add, of alum, ½ dr.; brandy, 2 fl. oz. In inflammation of the mouth and throat.

2. (*Cavarra.*) Alum, 3 dr.; water, 6 fl. oz.; dissolve. In offensive breath.

3. (*Foy.*) Alum, 1 dr.; tincture of myrrh, 2 fl. dr.; tincture of bark, 4 fl. dr.; honey of roses, 2 oz.; laudanum, 20 drops; wine, ⅔ pint. In scurvy.

4. (*Grant.*) Alum, 1 oz.; tincture of myrrh, ½ fl. oz.; peppermint water, 7 fl. oz. In relaxation of the uvula, &c.

5. (Mid. Hosp.) Alum, 1 dr.; honey, 2 dr.; water to make 6 fl. oz. As No. 4.

6. (P. Cod.) Alum, 40 gr.; honey of roses, 1 oz.; infusion of roses, 6 fl. oz. As the last.

7. (*Ratier.*) Alum, 1 oz.; infusion of red roses and barley water, of each, 3 fl. oz.; honey of roses, 2 oz. As No. 4.

8. (Westm. Hosp.) Alum, 1 dr.; dilute sulphuric acid, 1 fl. dr.; treacle, 4 dr.; water to 15 fl. oz.

9. (Ph. Wurtem.) Alum and nitre, of each, 3 oz.; cream of tartar, 4 oz.; dilute acetic acid, 4 lbs.; dissolve, evaporate to dryness, and powder the residuum. For use, ½ oz. of the powder is dissolved in water, 8 fl. oz. Highly recommended in inflammation of the fauces and tonsils. This forms Zobel's 'SPECIFIC FOR QUINSY.'

Gargle of Aluminium Chloride. *Syn.* GARGARISMA ALUMINII CHLORIDI, L. *Prep.* (Throat

Hosp.) Solution of chloride of aluminium, 12 minims; water, 1 fl. oz. Astringent and antiseptic.

Gargle, Antiscorbu'tic. *Syn.* GARGARISMA ANTISCORBUTICUM, L. *Prep.* (P. Cod.) Bitter species, 1 dr.; boiling water, 8 oz.; macerate 1 hour, strain, and add, syrup of honey, 2 oz.; antiscorbutic tincture, 1 oz.

Gargle, Antisep'tic. *Syn.* GARGARISMA ANTISEPTICUM, L. *Prep.* (Fr. Hosp.) Decoction of bark, 6 oz.; camphor, 20 gr.; sal-ammoniac, 12 gr. In putrid sore throat, &c.

Gargle, Astrin'gent. *Syn.* GARGARISMA ASTRINGENS, L. *Prep.* 1. (*Collier.*) Tincture of galls, 2 fl. dr.; honey, ½ oz.; water, 6 fl. oz. In relaxation of the uvula and fauces.

2. (*Collier.*) Honey, 4 dr.; tincture of myrrh, 3 dr.; powdered alum, 40 gr.; compound infusion of roses, 5½ fl. oz. As the last, and in fœtid sore throat.

3. (*Sir A. Cooper.*) Alum, 2 dr.; decoction of bark, 12 oz.; honey of roses, 1½ oz.

4. (*Dr A. T. Thomson.*) Infusion of roses, 7 fl. oz.; dilute sulphuric acid, 1 fl. dr.; tincture of catechu, 6 fl. dr.; laudanum, 1½ fl. dr. For relaxation of the uvula. See GARGLE OF ALUM.

Gargle of Bo''rax. *Syn.* GARGARISMA BORACIS, L. *Prep.* 1. (*Ellis.*) Borax, 1 dr.; tincture of myrrh, 4 fl. dr.; clarified honey, 1 fl. oz.; rose-water, 4 fl. oz.

2. (Fr. Hosp.) Borax, 2 dr.; honey or capillaire, 1 oz.; rose-water, 7 fl. oz.

3. (Guy's Hosp.) Borax, 2 dr.; honey of roses, 1 oz.; barley water, 7 fl. oz.

4. (Mid. Hosp.) Borax, 1 dr.; simple oxymel, 2 dr.; water to make 3 fl. oz. The above are used in thrush or aphthous sore mouth, ptyalism, &c.

Gargle of Bromide of Potassium. *Syn.* GARGARISMA POTASSII BROMIDI, L. *Prep.* (Throat Hosp.) Bromide of potassium, 10 gr.; water, 1 fl. oz. Sedative.

Gargle of Cap'sicum. *Syn.* GARGLE OF CAYENNE PEPPER; GARGARISMA CAPSICI, L. *Prep.* 1. (*Dr Griffith.*) Tincture of capsicum, ½ fl. oz.; rose-water, 8 fl. oz.

2. (St B. Hosp.) *a.* Capsicum, 3 dr.; common salt, 1 oz.; boiling water, 1 pint; macerate for 12 hours, strain, and add of distilled vinegar, 1 pint.

b. Tincture of capsicum, 1 fl. dr.; compound infusion of roses, 8 fl. oz.

3. (U. C. Hosp.) Tincture of capsicum, 1 fl. dr.; honey, 6 dr.; water to 4 fl. oz. Used in ulcerated sore throat, scarlet fever, &c.

Gargle of Carbolic Acid. *Syn.* GARGARISMA ACIDI CARBOLICI, L. *Prep.* (Throat Hosp.) Carbolic acid, 2 gr.; glycerin, 25 minims; water, 1 fl. oz. Stimulant and antiseptic.

Gargle of Chlo''rate of Potas'sa. *Syn.* GARGARISMA POTASSÆ CHLORATIS, L. *Prep.* (*Beasley.*) Chlorate of potassa, 1 dr.; honey of roses, 1 oz.; water, 7 oz. Used in malignant sore throat, scarlatina, &c.

Gargle of Chlo''ride of Lime. *Syn.* GARGARISMA CALCIS CHLORINATÆ, L. *Prep.* From chloride of lime, 1 dr.; water, ½ pint; agitate together for 10 minutes, filter through linen, and add of simple syrup, 1 fl. oz. Used in putrid sore throat, scarlet fever, &c.

Gargle of Chloride of So'da. *Syn.* GARGARISMA SODÆ CHLORINATÆ, L. *Prep.* 1. (*Copland.*) Liquor of chloride of soda, 12 fl. dr.; honey, ½ oz.; water, 6 fl. oz.

2. (Hosp. Form.) Chlorinated solution of soda, 4 fl. dr.; water to 4 fl. oz. Used as the last.

Gargle of Chlo''rine Water. *Syn.* GARGARISMA CHLORINII, L. *Prep.* 1. (Fr. Hosp.) Chlorine water, ½ fl. oz.; syrup, 1 fl. oz.; water, 4½ fl. oz.

2. (Mid. Hosp.) Chlorine water, 2 fl. oz.; distilled water, 10 fl. oz.—*Use.* As the last.

Gargle of Cincho'na Bark. *Syn.* GARGARISMA CINCHONÆ, L. *Prep.* 1. From decoction of cinchona, 7 fl. oz.; simple oxymel, 1 fl. oz. Antiseptic and astringent in relaxation, &c.

2. (Acidulated: GARGARISMA CINCHONÆ ACIDUS, L.) Hydrochloric acid, 1½ fl. dr.; honey, 1½ oz.; decoction of bark to make up 8 fl. oz.

Gargle, Com'mon. *Syn.* GARGARISMA COMMUNE, L. *Prep.* 1. (Ed. Hosp.) Water, 6 fl. oz; nitre, 1 dr.; honey of roses, 1 oz. For ordinary sore throat, &c.

2. (Lond. Hosp.) Alum, 1 dr.; dilute sulphuric acid, 2 fl. dr.; tincture of myrrh, 4 fl. dr.; water to 12 fl. oz.

Gargle of Cy'anide of Mercury. *Syn.* GARGARISMA HYDRARGYRI CYANIDI, L. *Prep.* 1. (*Brera.*) Cyanide of mercury, 10 gr.; honey of roses, 1 oz.; barley water, 1 pint.

2. (*Cullerier.*) Cyanide of mercury, 10 gr.; linseed tea, 1 pint. Used in the same cases as mercurial gargle.

Gargle, Deter'gent. *Syn.* GARGARISMA DETERGENS, L. *Prep.* 1. (P. Cod.) Alcoholised sulphuric acid, 1 fl. dr.; honey of roses, 2 oz; barley water, 8 oz.

2. (*Dr A. T. Thomson.*) Nitre, 2 dr.; honey of roses, 4 fl. dr.; infusion of roses, 5½ fl. oz. In inflammatory sore throat.

Gargle, Emol'lient. *Syn.* GARGARISMA EMOLLIENS, L. *Prep.* 1. (*Buchan.*) Marsh-mallow root, 1 oz.; figs, 2 oz.; water, 1 quart; boil to a pint and strain. Demulcent, soothing.

2. (*Trousseau* and *Reveil.*) Barley water, 8 oz.; honey, 1½ oz. Both are used in inflammatory affections of the throat and mouth.

Gargle of Horserad'ish. *Syn.* GARGARISMA ARMORACIÆ, L. *Prep.* (*Collier.*) Compound spirit of horseradish, 1 fl. oz.; honey, 2 oz.; water, 4 fl. oz. A good gargle for scurvy of the fauces and pharynx, vulgarly called the 'inward scurvy.'

Gargle of Hydrochlo''ric Acid. *Syn.* MURIATIC ACID GARGLE; GARGARISMA ACIDI HYDROCHLORICI, L. *Prep.* 1. (Guy's Hosp.) Hydrochloric acid, 30 drops; honey of roses, 2 oz.; barley water, 6 fl. oz.

2. (*Ratier.*) Hydrochloric acid, 2 fl. dr.; clarified honey, 2 fl. oz.; barley water, 1 pint.

3. (St B. Hosp.) Red rose leaves, 2 dr.; boiling water, 1 pint; hydrochloric acid, 1½ fl. dr.; digest 1 hour and strain. In inflammatory sore throat, ulcerations of the mouth, scarlet fever, &c.

Gargle of I'odine. *Syn.* GARGARISMA IODINII, L. *Prep.* 1. Iodine, 10 gr.; iodide of potassium, 12 gr.; rectified spirit and simple syrup, of each, 1 fl. oz.; water, 5 fl. oz. In chronic enlargement of the tonsils, in scrofulous habits.

2. (*Dr Ross.*) Tincture of iodine, 1½ fl. dr.; tincture of opium, 1 fl. dr.; water, 6 fl. oz.

3. (St T. Hosp.) Compound tincture of iodine, 2 fl. dr.; water, 5 fl. oz. In ulceration of the tonsils.

Gargle, Mercu″rial. *Syn.* GARGARISMA HYDRARGYRI, G. MERCURIALE, L. *Prep.* 1. (G. HYD. BICHLORIDI.) Corrosive sublimate, 2 to 5 gr.; barley water, 1 pint; honey of roses, 2 fl. oz. For syphilitic ulcers in the throat.

2. (*Plenck.*) Calomel, 6 gr.; quicksilver, 30 gr.; powdered gum, 3 dr.; syrup of poppies, ½ oz.; triturate till the globules of metal disappear, and add of decoction of clematis, 26 fl. oz.; honey of roses, 1 oz.; essence of myrrh, 1 dr. (or tincture of myrrh, 1 fl. oz.). In syphilitic and putrid sore throat.

Gargle of Mustard. *Syn.* GARGARISMA SINAPIS. *Prep.* (*Fleury.*) Black mustard-seed, bruised, 4 oz.; salt, 4 scruples; vinegar, 8 scruples; warm water, 7 oz. Digest and filter.

Gargle of Myrrh. *Syn.* GARGARISMA MYRRHÆ, L. *Prep.* 1. (*Ainslie.*) Tincture of myrrh, 6 fl. dr.; vinegar, 1 fl. dr.; honey of roses, 1½ fl. oz.; barley water, 12 fl. oz.

2. (Ph. Chirur.) Tincture of myrrh, ½ oz.; honey of roses, 1½ oz.; lime water, 6 fl. oz. In scarlatina and putrid sore throat. See ASTRINGENT GARGLE, &c.

Gargle of Ni′tro. *Syn.* GARGARISMA SALIS NITRI, G. POTASSÆ NITRATIS, L. *Prep.* 1. Nitre, 2 dr.; honey or syrup, ½ oz.; rose-water, 5½ fl. oz.

2. (*Brande.*) Nitre, 2 dr.; oxymel, 1 fl. oz.; barley water, 7 fl. oz. In inflammatory sore throat. See COMMON GARGLE.

Gargle of Oak-bark. *Syn.* GARGARISMA CORTICIS QUERCÛS, L. *Prep.* 1. Oak-bark, 2 dr.; boiling water, 6 fl. oz.; macerate 1 hour and strain.

2. (*Ellis.*) Decoction of oak-bark, 1 pint; alum, ½ dr.; brandy, 2 fl. oz. In chronic sore throat, relaxation of the uvula, &c.

Gargle of Permanganate of Potash. *Syn.* GARGARISMA POTASSÆ PERMANGANATIS. *Prep.* (Throat Hosp.) Solution of permanganate of potash (B. P.), 6 minims; distilled water, 1 fl. oz. Antiseptic.

Gargle of Ro″ses. *Syn.* GARGARISMA ROSÆ, G. ROSARUM, L. *Prep.* (*Kendrick.*) Conserve of roses, 3 oz.; boiling water, 16 fl. oz.; infuse 1 hour; add of dilute sulphuric acid, 2 fl. dr. and strain. Antiseptic, astringent; used in several indications.

Gargle of Subacetate of Lead. *Syn.* GARGARISMA PLUMBI SUBACETATIS. *Prep.* (*Ratier.*) Liquid subacetate of lead, ½ dr.; barley water, 1 lb.; syrup, 1 fl. oz.

Gargle of Turpentine. *Syn.* GARGARISMA TEREBINTHINATUM. *Prep.* (*Geddings.*) Oil of turpentine, 2 dr.; mucilage, 6½ fl. oz. In salivation.

Gargle, Spirit. *Syn.* GARGARISMA SPIRITUOSUM, G. SPIRITÛS VINI, L. *Prep.* 1. (*Dr Watson.*) French brandy, 1 fl. oz.; water, ¼ pint.

2. (St George's.) Proof spirit, 1 fl. oz.; oxymel, 5 fl. dr.; decoction of barley, to make up 6 fl. oz. In relaxations and salivation.

Gargle, Stim′ulant. *Syn.* GARGARISMA STIMULANS, L. *Prep.* (*Dr Copland.*) Infusion of roses, 6½ fl. oz.; dilute hydrochloric acid, 40 drops; tincture of capsicum, 1½ fl. dr.; honey, 3 dr. See GARGLE OF CAPSICUM.

Gargle of Tan′nin. *Syn.* GARGARISMA ACIDI TANNICI, L. *Prep.* 1. (*Beral.*) Tannin, 1 dr.; honey of roses, 2 oz.; rose-water, 2 fl. oz.; distilled water, 8 fl. oz.

2. (*Jannart.*) As the last, but using only half the quantity of tannin. In salivation and aphthous ulcerations.

Gargle of Verd′igris. *Syn.* GARGARISMA ÆRUGINUS, G. CUPRI ACETATIS, L. *Prep.* (Guy's Hosp.) Oxymel of verdigris, 4 dr.; honey of roses, 2 oz.; barley water, 3½ fl. oz. Used as a detergent for ulcers in the throat. If swallowed it produces violent vomiting. The addition of 2½ oz. of water to the above produces a gargle sufficiently strong for most cases.

Gargle of Vin′egar. See GARGLE OF ACETIC ACID.

Gargle of Zinc. *Syn.* GARGARISMA ZINCI, G. Z. SULPHATIS, L. *Prep.* (*Dr Copland.*) Sulphate of zinc, 20 gr.; oxymel, 1 fl. oz.; rose-water, 7 fl. oz. In aphthous sores, relaxations, ulceration of the tonsils, &c.

GAR′LIC. *Syn.* ALLIUM, L. The *Allium sativum* of botanists. It is diaphoretic, diuretic, expectorant, stimulant, and tonic; and externally, irritant, rubefacient, and even vesicant.—*Dose*, ½ dr. to 1½ dr.; in enfeebled digestion, chronic diarrhœa, old chronic coughs, atonic dropsies, and worms. An antispasmodic and counter-irritant liniment is made of the juice, which was formerly esteemed in chest diseases and infantile convulsions. A small clove of garlic, or a few drops of the juice, was formerly introduced into the ear in certain forms of deafness. As a condiment its properties resemble those of the onion, than which it is very much more powerful.

GAR′NET. In *mineralogy*, one of the precious stones or gems. The finest specimens of noble garnet (SYRIAN or ORIENTAL GARNET) are brought from Pegu. According to chemical analysis, the garnet is a double silicate of alumina and lime, coloured with iron and manganese.

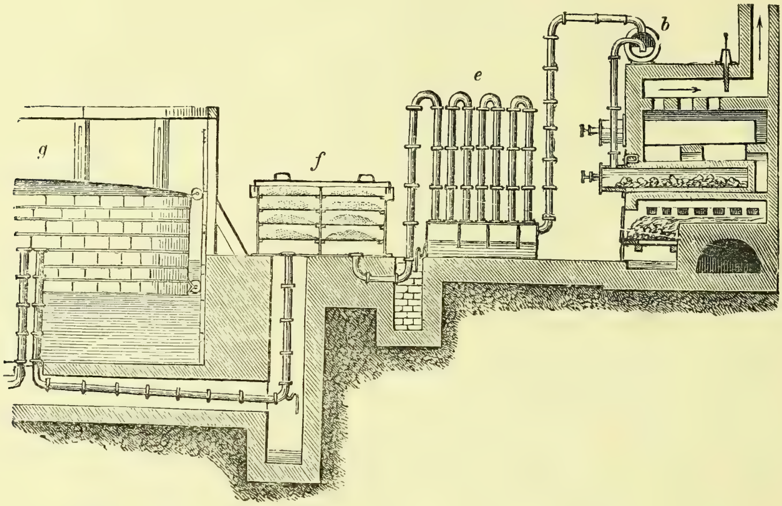
Garnet, Facti″tious. See PASTES.

GA′RUM. [L.] A species of pickle or sauce prepared of fish in a state of incipient putrefaction, strongly salted and seasoned with aromatics. According to Pliny, the Romans used a species of lobster for this purpose.

GAS. *Syn.* GAZ, Fr. A permanently elastic aëriform fluid. In English the term 'air' is now usually restricted to the gaseous mixture forming the atmosphere, but it was formerly used as a synonym for 'gas.' The principal gases are the elementary bodies hydrogen, chlorine, oxygen and nitrogen, and the compounds ammonia, carbonic acid, carbonic oxide, carburetted hydrogen, hydrochloric acid, phosphoretted hydrogen, protoxide of nitrogen, sulphuretted hydrogen, and sulphurous acid. See these substances under their respective heads.

Gas. *Syn.* COAL-GAS, ILLUMINATING G. The term 'gas' is popularly applied to the important mixture of hydrocarbons produced by the destructive distillation of pit-coal, and now employed as a source of artificial light in nearly

all the towns of Europe and America. Although artificial illumination by means of coal-gas was, previous to 1819, used in Great Britain in isolated cases, and had been employed for the occasional lighting up of the mansion of Culrose Abbey in Scotland, by Lord Dundonald, as far back as 1787; and by Murdoch, in 1798, for lighting the foundry of Boulton and Watts in Soho, it does not appear to have been generally adopted in London and the other large towns of England and Scotland until that year; since that time to the present, artificial gas illumination has steadily progressed, and increased to so enormous an extent, that some works are now delivering millions of cubic feet of coal-gas a day. The apparatus used in the manufacture of gas on the large scale consists essentially of a system of closed retorts (a) of cast iron or fire-clay, generally having the form of a flattened cylinder, arranged in sets of three or five, and heated by the same coal fire, as shown in the accompanying *engr*.



The quantity of coal required to charge each retort is about two bushels, and it takes about four hours for the coal to give off all its gas. When it has done this, the resulting coke is removed from the retort, and a fresh charge of coal is thrown into it, the mouth of the retort being then closed with a thick iron plate. An iron pipe ascends from the upper side of the front of the retort, projecting from the furnace, and after describing a curve at its upper extremity, this iron pipe opens into a much wider tube, called the *hydraulic main* (b), which passes horizontally along the front of the range of furnaces, the tubes from all the retorts dipping into it. The hydraulic main is always kept half full of the water and the tar which condenses from the ascending gas; by means of this arrangement the opening into each retort is effectually closed by a water-valve, and a fresh charge of coals may be thrown into any one or more of the retorts without interfering with the distillation going on in the others; or coke may be withdrawn in the same manner.

The aqueous portion of the liquid deposited in the hydraulic main, which is known as the *ammoniacal liquor*, and forms the principal source of the commercial salts of ammonia, consists principally of solution of carbonate of ammonium, but contains also sulphide, cyanide, and sulphocyanide of ammonium. After it leaves the hydraulic main, the gas passes into the *condenser* (e), which is composed of a series of bent iron tubes (shown in the *engr*.), these being kept cool either by the large surface they expose to the air, or, if necessary, by means of a stream of cold water applied to the outside.

Most of the volatile hydrocarbons or salts of ammonia escaping condensation in the hydraulic main are arrested in the condensers, but it is necessary to afterwards carry the gas through a *scrubber* (not figured in the *engr*.) or case containing pieces of coke, over which a stream of water trickles; this absorbs any remaining ammoniacal vapours. The gas next passes through the lime *purifier* (f), an iron box fitted with shelves, on which is placed slaked lime, this absorbs the carbonic acid, and part, but not the whole of, the sulphuretted hydrogen contained in the gas. Of the many methods devised for the removal of the sulphuretted hydrogen, none appears to be so successful and economical as that which consists in passing the gas over a mixture of sulphate of iron, slaked lime, and sawdust.

The gas, after it has become purified by the foregoing processes, is passed into the gasometer (g) (part of which is represented in the *engr*.), whence it passes into the mains. Another prejudicial impurity formed in gas is carbon disulphide; this, when burned, gives rise to small quantities of sulphuric acid, which in time attacks certain kinds of furniture, as well as the bindings of books.

The quality of coal-gas is largely dependent upon the temperature employed in its manufacture. If the retorts are insufficiently heated the result will be the formation of certain easily condensable hydrocarbons, which not only diminish the bulk of the gas, but cause considerable inconvenience by collecting in and blocking up the pipes. On the contrary, should too much heat be used, the gas becomes partially decomposed by contact with the red-hot retort, and deposits on its sides the substance known as 'gas carbon,' thus not only removing to a certain extent the constituent to which the gas owes its illuminating power, but impoverishing its lighting powers still more by diluting it with an unnecessary quantity of liberated hydrogen. These latter effects are forcibly illustrated in the following analysis of the gas collected from Wigan cannel coal at different periods of the distillation.

The best gas is said to be produced when the retorts are heated to a bright cherry red.

In 100 Volumes.	1st Hour.	5th Hour.	10th Hour.
Olefiant gas and volatile hydrocarbons	13·0	7·0	0·0
Marsh gas. . . .	82·5	56·0	20·0
Carbonic oxide . .	3·2	11·0	10·0
Hydrogen	0·0	21·3	60·0
Nitrogen	1·3	4·7	10·0

The chief substances produced by the dry distillation of coal are:

Gaseous. Hydrogen, marsh gas, carbon monoxide, ethylene, propylene, acetylene, carbon dioxide, sulphuretted hydrogen, and nitrogen.

Liquid. Water, carbon disulphide, benzene, toluene, xylene, cumene, cymene, aniline, picoline, leucoline, phenol, &c.

Solid. Ammonium carbonate, sulphide, sulphite, chloride and cyanide, naphthalene, chrysene, anthracene, &c.

Most of the solid and liquid substances are removed by condensation in the hydraulic main or the refrigerator. The still gaseous portions may be subdivided into illuminants, diluents, and impurities.

Illuminants. Ethylene, propylene, butylene, acetylene, &c.

Diluents. Hydrogen, marsh gas, carbon monoxide.

Impurities. Sulphuretted hydrogen, ammonium sulphide, ammonium carbonate, carbon dioxide, carbon disulphide, nitrogen, oxygen, and aqueous vapour.

The impurities are removed as far as possible in the process of purification.

The yield of gas, and also the illuminating power of the product, vary greatly with different kinds of coal. The average yield may be roughly estimated at 10,000 cubic feet of gas per ton of coal.

Anthracite is by no means suited for a gas coal. The best coals for this purpose are those which are bituminous; they comprise caking coal, parrot coal, and certain varieties of cannel coal. London gas is manufactured principally from Durham and Newcastle coal.

In addition to the elementary composition of the coal, the amount and nature of the volatile matter contained in it is an important factor in its value as a source of gas. It should also yield a small amount of ash, and be as free as possible from sulphur, besides which its ultimate analysis should show a comparatively small proportion of oxygen. If there be an excess of this latter element the production of the hydrocarbon illuminants will be diminished, since the hydrogen which would go to their formation would unite with the oxygen to form useless water.

Charles Mansfield proposed to increase the illuminating power of ordinary coal gas, and to render water-gas, or even atmospheric air, luminiferous by passing them through sponges or over trays containing mineral naphtha or benzole; and a patent was taken out for this purpose. The gas so treated takes up a portion of the liquid, and burns with increased brilliancy. The method of saturating the gas with the liquid hydrocarbon is as follows:—"The apparatus consists of a brass reservoir or chamber attached to the end of the gas-pipe near the burner. This reservoir may be in the shape of an oil-flask, made air-tight with a screw-joint, or other means of supplying any highly volatile oil, turpentine, or mineral naphtha, and should be kept about half full. Into this reservoir the gas-pipe ascends a little above the surface of the oil; a very small jet-pipe of gas, regulated by a stopcock, is branched off below this chamber to supply a minute flame, so as to cause a sufficient evaporation from the oil to unite with the gas in the flask receiver. The whole is, of course, surmounted with the usual burner and lamp-glass."

The naphthalising of gas did not work well on a large scale. On a small scale, however, simple 'naphthalisers' appear to work very well.

The illuminating power of gas, as well as of other sources of light, may be directly ascertained by what is termed the 'comparison of shadows,' or indirectly by chemical analysis. See AIR, GAS, ILLUMINATION.

For further details respecting the manufacture of coal gas consult Ure's 'Dictionary of Arts and Manufactures,' or Wagner's 'Chemical Technology.'

GAS REGULATORS. See REGULATORS.

GASTROPHAN. (Apotheker *J. Fürst*, Prague.) For strengthening the digestion and improving the appetite. Quassia, 30 grms.; orange berries, 15 grms.; galangal, 4 grms.; cardamoms, 2 grms.; star-anise oil, 10 drops; orange-peel oil, 10 drops; spirit, 180 grms.; water, 120 grms.; digested and filtered (*Hager*).

GAZ'OGENE. [Fr.] *Syn.* AËRATING MACHINE. A portable apparatus for aërating water and other liquids. Many forms have been given to this instrument, but in all the principle is the same. Powders for generating carbonic acid gas are placed in a separate compartment, and the liquid to be aërated in another. The two compartments are connected by a suitable tube, and a second tube, furnished with a spring tap, affords an exit for the aërated liquid. By the aid of the gazogene, water, wine, ale, &c., may in a few minutes be fully saturated with carbonic acid gas, and so rendered brisk and piquant.

By using fruit syrups, manufactured from English and foreign fruits, the most delicious aërated summer beverages can be made, resembling those so much esteemed by travellers in the South of Europe and the sea-board cities of the Western world.

The following are the proportions of soda and acid required for charging gazogenes :

For 2 pints, powdered tartaric acid, 280 gr.; bicarbonate of soda, 340 gr.

For 3 pints, powdered tartaric acid, 340 gr.; bicarbonate of soda, 420 gr.

For 5 pints, tartaric acid, 620 gr.; carbonate of soda, 760 gr.

Put the acid and soda in different coloured papers.

GEDACHTNISS-LIMONADE—**Mnemonic Lemonade** (manufactured by G. M. Raufer, Vienna). A mixture of 15 parts phosphoric acid, 15 parts glycerin, 70 parts water (*Schädler*).

GEHOR LIQUOR, Schweizer—Swiss Cure for Deafness. (*Raudnitz.*) Water mixed with a little coarse brandy (*Wittstein*).

GEHOROL—Oil for Deafness. (*C. Brockelmann*, Soest.) Provence oil adulterated with sunflower oil and mixed with very small traces of camphor and cajeput, sassafras, and rosemary oils (*Hager*).

GEL'ATIN. *Syn.* GELATINE; GÉLATINE, Fr.; GELATINA, L. Animal jelly, obtained by the prolonged action of boiling water on the organic tissue of the bones, tendons, and ligaments, the cellular tissue, the skin, and the serous membranes. Glue and size are coarse varieties of gelatin, prepared from hoofs, hides, skins, &c.; and isinglass is a purer kind, obtained from the air-bladders of some other membranes of fish.

Prop., &c. Gelatin is insoluble in cold water, but dissolves with greater or less readiness on the application of heat according to the source whence it is obtained, and in this state forms a tremulous and transparent jelly on cooling; it is insoluble in both alcohol and ether, and is decomposed by the strong alkalies and acids; with tannic acid it forms an insoluble compound of a buff colour, which is the basis of leather; when acted on by cold concentrated sulphuric acid, it yields glycocoll or gelatin sugar; and when boiled with strong alkalies, it yields glycocoll and leucine. Chlorine passed into a solution of gelatin occasions a dense white precipitate (chlorite of gelatin), which ultimately forms a tough, elastic, pearly mass, somewhat resembling fibrin.

Tests. Its aqueous solution is recognised as follows:—1. It gelatinises on cooling. 2. It is precipitated by alcohol. 3. Bichloride of mercury gives a whitish flocculent precipitate. 4. Tannic acid or infusion of galls gives a copious yellowish-white, curdy precipitate, which, on being stirred, coheres into an elastic mass, insoluble in water, and incapable of putrefaction, and which, when dried, assumes the appearance of over-tanned leather. 5. The gelatinising property is destroyed by nitric acid. 6. It is not effected by either alum or acetate of lead. In this respect it differs from chondrin.

Qual. The goodness of commercial gelatin intended for food is readily proved by pouring boiling water over it, and digesting the two together for a short time. If it is pure and wholesome, its colour remains unaltered, and during its solution in continues entirely free from smell. The resulting solution and jelly are also odourless, neutral to test-paper, free from unpleasant taste, and perfectly transparent. If it forms a yellow gluey-looking mass, and evolves an offensive odour, it should be rejected as of inferior quality, and unfit for culinary purposes.

Uses, &c. Gelatin is largely employed as an article of food, as in soups, jellies, &c.; but its value in this respect has been, perhaps, overrated. (The reader interested in this subject should consult a paper by Carl Voit in the 'Zeitschrift für Biologie,' viii, 297—388.) Animals fed exclusively on gelatin die of starvation. But when mixed with other food, especially with substances abounding in albumen, casein, or fibrin, gelatin may be useful as an aliment, and serve directly to nourish the gelatinous tissues (*Liebig*). Hence gelatin is a fitting substance to form part (but only a part) of the diet of convalescents, as it conveys nutrition directly to these tissues, without tasking the diminished powers of life for its conversion; but its use should be accompanied by a proper quantity of azotised animal food to supply the elements to the blood, for the support and increase of the muscular tissue, or fleshy portion of the body. In France gelatin obtained from bones is employed as a part of the diet in hospitals with the best effect, materially abridging the period of convalescence; but when given alone, all animals soon become disgusted with it, and die if not supplied with other food (*D'Arcet*). See GLUE, ISINGLASS, and *below*.

Gelatin, Bone. Obtained from crushed bones by boiling with water, or by the action of steam and water successively, either with or without pressure; or by maceration in dilute hydrochloric acid, to extract the phosphate of lime, the remaining gelatinous mass being well washed in cold water, and afterwards dissolved in boiling water in the usual manner. A little carbonate of soda is commonly added to the last water. Gelatin has even been extracted from fossil bones. "A soup was prepared from one of the bones of the great mastodon by the Préfet of one of the Departments of France" (*Pereira*). Butchers' meat contains on an average, 24% of dry flesh, 56% of water, and 20% of bone. The last will yield, by proper treatment, nearly 1-3rd of its weight of dry gelatin, or a quantity equal to about 6% of the meat from which it is cut. This, as well as other varieties of gelatin, is frequently blanched by sulphurous acid or animal charcoal, and tinged of various colours with the ordinary vegetable dyes. Thus, blue is given with sulphate of indigo or the juice of blue berries; green, with the juice of spinach; and red, with the juice of red beet.

Gelatin, French. *Syn.* CAKE GELATIN. Gelatin made up into small thin cakes, like the finer sorts of glue. A good deal of it is prepared in Paris from the cuttings of the skins used in making kid gloves and slippers.

Gelatin, Patent. Various qualities of gelatin are manufactured from glue pieces or cuttings of the hides of beasts and skins of calves, and from inferior isinglass. According to Mr Nelson's

specification, the crude materials, freed from hair, wool, flesh, and fat, after being thoroughly washed and 'scored,' are macerated for 10 days in a ley of caustic soda, and are then placed in covered vessels at a temperature varying from 60°—70° F., until they become tender; they are next washed to free them from alkali, and are then exposed to the vapour of burning sulphur until they acquire a sensibly acid reaction; they are now dissolved in water contained in earthen vessels heated to 150° F., and the solution, after being strained, is put into 'settling vessels,' and and heated to 100°—120° F., for 8 or 9 hours; at the end of this time the clear liquor is drawn off, and poured on the 'cooling slabs,' to the depth of about ½ an inch. As soon as the jelly is cold, it is cut into pieces and washed in water until perfectly free from acid. It is then redissolved in water at about 85° F., the solution poured out on slabs as before, and when cold, it is cut up, and, lastly, dried on nets.

According to another specification (*Rattray's* Patent) glue-pieces are steeped in water until they begin to putrefy, then washed with water, drained, and put from 12 to 24 hours into water strongly soured with sulphurous acid; they are afterwards washed first with cold water, and then in water at 120° F., and are lastly converted into size by digestion for 24 hours in water at 120° F., the resulting solution being filtered through bags of double woollen cloth.

Patent gelatins are often sold cut up in imitation of 'picked isinglass,' to which, for the preparation of jellies, soups, and blancmanges, they are not much inferior.

Gelatin, Rough. *Syn.* GELATINE BRUT, Fr. From the skulls of oxen, the spongy insides of the horns and ribs, and from several other soft bony parts (deprived of fat), by washing them in water, digesting in an equal weight of hydrochloric acid of 6° Baume, in cold weather, and 4° or 5° in summer for 10 days, then in acid of only 1° Baume for 24 hours longer; afterwards soaking and washing in successive portions of cold water until all the acid is washed out, adding 1 oz. of carbonate of soda to the last water. Used to make glue, &c. A similar article is prepared from the bones of sheep. The pieces, after being treated as above, are steeped in boiling water for in few minutes, wiped dry, and shaken together in a bag to remove the internal pellicle; after which they are cut into squares or dice to disguise them, and finally dipped into a hot solution of gelatin to varnish them. In this state the article is called 'GELATINE BRUT FIN.' Used to make soup. It keeps better than the cakes of portable soup. When less carefully prepared, it is also used to make glue for fine work. See BONE GELATIN.

GELÉE (pour le Goitre). See LINIMENT OF IODIDE OF POTASSIUM.

GELSEMIUM SEMPERVIRENS. *Syn.* GELSEMIUM NITIDUM, GELSEMINUM SEMPERVIRENS, GELSEMIUM LUCIDUM, ANONYMUS SEMPERVIRENS, BIGNONIA SEMPERVIRENS, LISANTHUS SEMPERVIRENS. The YELLOW JASMINE, or WOODBINE. The CAROLINA JASMINE.

Different botanists have placed the plant in different natural orders. De Candolle assigns it to the LOGANIACEÆ; Decaisne to the APOCYNACEÆ; Chapman to the RUBIACEÆ.

The rhizome and rootlets, which are the only parts of this plant employed in medicine, and of which a fluid extract has been introduced into the United States Pharmacopœia, as met with in English commerce occurs in two states; either in packets prepared by the shakers of New Lebanon, which contain the root in small pieces, formed into a compact mass by hydraulic pressure, and in which state it is difficult to powder; or it is simply sold cut up into pieces varying from 2 to 8 inches in length, and 1-3rd to 3-4ths of an inch in diameter. It is frequently mixed with about half its bulk of long, wiry, pale brown rootlets.

The so-called gelsemium root consists chiefly of subterranean stem with a small proportion of true root; occasionally a slender piece of the aërial stem may be found intermixed, and is readily distinguished by its purplish colour and hollow centre, and by the silky and tow-like fibre, rendered visible when the epidermis is peeled off.

Med. Prop. The American medical journals record the successful administration of gelsemium in a great number and variety of diseases, including intermittent, remittent, typhoid, and yellow fevers, the irritative fevers of childhood, inflammation of the lungs and pleura, dysentery, rheumatism, and other inflammatory affections, neuralgia, obstinate menstruation, delirium tremens, morbid wakefulness, St Vitus' dance, hysteria, epilepsy, spasmodic stricture of the urethra, and gonorrhœa. Dr Hurd, an American physician, reports very favourably of the drug as a cardiac sedative, and considers it more efficient than any other remedy in the palpitation and the difficult breathing that accompany heart disease; and Dr Hill, of Maine, finds it, when combined with bromide of potassium, useful in irritable bladder.

Its principal use, however, in American medical practice has been as a febrifuge. In periodic fevers it has been employed with great advantage, as well as in cases of intermittent fever, which, having failed to yield to quinine alone, succumbed when this latter medicine was combined with gelsemium.

In England gelsemium has been successfully employed for the relief of facial neuralgia, or of the pain caused in the face and jaws by decayed teeth; as well as in obscure nervous affections and severe headaches. It is given principally in the the form of tincture; but sometimes in powder in doses of from 1 to 2 gr.

The therapeutic action of gelsemium is believed to be due to the sedative effect it exercises on the nervous and arterial systems—hence its power in controlling the nervous irritability so prevalent during fever. In moderate doses it causes a sensation of agreeable languor, accompanied with muscular relaxation; in larger doses, dizziness, dilated pupil, double vision, general muscular debility and prostration; these symptoms being accompanied by a diminution in the force and frequency of the pulse as well in the respiration. At the same time the patient becomes insensible to pain; but is free from stupor and delirium. These symptoms are said to pass off, after a time, and to be attended with no unpleasant results.

The 'Lancet,' as well as many of the American medical journals, record several cases of poisoning arising from giving an overdose of this drug. The symptoms are a great prostration of nervous energy accompanied by paralysis of sensation and motion. When death occurs it is probably owing to syncope. The antidotes are, first, an emetic, and after this has acted, stimulants, such as carbonate of ammonia with brandy, or aromatic spirits of ammonia. In cases accompanied with insensibility, recourse should be had to electricity.

Kollock, in the 'American Journal of Pharmacy' for 1855, states that he found the root on analysis to yield volatile oil, dry acrid resin, fatty resin, fixed oil, gallic acid, starch, pectic acid, albumen, extractive matter, lignin, gum, a yellow colouring matter, mineral matter (chiefly salts of potassium, calcium, magnesium, iron, and silica), and an alkaloid, to which the name gelseminine or gelsemia has been given. Kollock also states that the leaves and flowers contain the same ingredients as the root, although in much smaller quantities.

Eberle, in the 'American Journal of Pharmacy' for 1864, says he failed to obtain gelseminine from the root. In a paper contributed to the 'American Journal of Pharmacy' for January, 1870, by Dr Wormley, the author stated that he said he not only succeeded in obtaining pure gelseminine from the root, but also a peculiar acid which he calls gelseminic, or gelsemic acid; which he regards as existing in combination with the gelsemia, forming the gelsemate of gelsemia. Professor Sonnenschein having submitted the so-called *gelseminic acid* to analysis, thinks there can be no doubt that it is perfectly identical with æsculin, a glucoside obtained from the bark of the horse-chestnut—the *Æsculus hippocastanum.*

In the 'American Journal of Pharmacy' for April, 1877, Dr Wormley gives the following directions for the preparation of gelseminic acid and gelsemine:—A given volume of the fluid extract, acidulated with acetic acid, is slowly added with constant stirring to about 8 vols. of water; after the separated resinous matter has completely deposited, the liquid is filtered, and the filtrate concentrated on a water-bath, to something less than the volume of fluid extract employed. The gelseminic acid is then extracted from the concentrated fluid by ether, after which the liquid is treated with slight excess of carbonate of sodium, and the gelsemine extracted with ether or chloroform. For the extraction of the first of these principles it is not essential that the liquid should be acidulated, but in the presence of a free acid the results are more satisfactory.

Sonnenschein gives the formula of the alkaloid gelseminine as $C_{11}H_{19}NO_2$; but Gerrard, who made a recent analysis of the pure crystalline base, found the formula $C_{12}H_{14}NO_2$. Pure gelseminine when dissolved in strong sulphuric acid, on the addition of a trace of manganese dioxide gives a deep crimson-red colour passing to green. The red colour is intense enough to cause it to be mistaken for strychnia; but if a parallel experiment be conducted with strychnia the two cannot be mistaken, for the strychnia gives an intense purple.

Gelseminine hydrobromide has been given in doses of $\frac{1}{100}$ to $\frac{1}{50}$ gr.

GEMS. *Syn.* Jewels; Gemmæ, L. "Gems are precious stones, which, by their colour, limpidity, lustre, brilliant polish, purity, and rarity, are sought after as objects of dress and decoration. They form the principal part of the crown jewels of kings, not only from their beauty, but because they are supposed to comprise the greatest value in the smallest bulk; for a diamond, no larger than a nut, or an acorn, may be the representative sign of the territorial value of a whole country, the equivalent in commercial exchange for a hundred fortunes, acquired by severe toils and privations." "Among these beautiful minerals mankind have agreed in forming a select class, to which the title of gems or jewels has been appropriated; while the term precious stone is more particularly given to substances which often occur under a more considerable volume than fine stones ever do. Diamonds, sapphires, emeralds, rubies, topazes, and chrysoberyls, are reckoned the most valuable gems; crystalline quartz, pellucid, opalescent, or of various hues, amethyst, lapis lazuli, malachite, jasper, agate, &c., are ranked in the much more numerous and inferior class of ornamental stones" (*Ure*).

Tests. The only tests applicable to gems and precious stones are the determination of their relative hardness and their specific gravity. By the first test, pastes or artificial gems are readily detected; but beyond this, owing to the difficulty of applying it, it ceases to be useful to persons not connected with the trade. The determination of the specific gravity is, however, of more general application, as gems are generally dismounted when offered for sale, or are so set that they may be removed from their 'mountings' without injury or inconvenience. See Specific Gravity, and *below*.

Obs. The relative hardness of the different substances is measured by the power they possess of cutting or scratching the other substances having a smaller number attached to them in the table. Thus, no gem but the diamond (20) will scratch either the ruby (17) or the sapphire (16); and, for the same reason, a blue stone that will cut the emerald or the topaz can be no other than the sapphire. The sp. gr. is ascertained in the usual manner, and will be found sufficiently indicative of the true nature of the stone when considered in connection with its other characteristics. The index of refraction is a certain key to the quality of the stone, in the hands of those who are capable of determining it, and may be applied to either mounted or unmounted gems. The most convenient instrument for the purpose is Wollaston's 'reflecting goniometer.'

Gems, Artificial. These, with few exceptions, are made of very pure, fusible, highly transparent, and dense glass, usually termed 'paste' or 'strass,' which is generally formed of oxide of lead, potash, and silica, with small quantities of other ingredients to increase the brilliancy and clearness. The characteristic tints are imparted by the addition of metallic oxides. The beauty of artificial stones and gems depends chiefly upon the exact imitation of the tint of the real stones, and upon the care and skill exercised in cutting, polishing, and mounting them. All the coloured

glasses and enamels may be worked up into artificial gems.

MM. Fremy and Feil have manufactured artificial corundum, ruby, and topaz, having a composition the same as the natural stones. The process by which they have effected this consists in fusing together at a red heat, in the furnace of a glass-works for a considerable time, a fusible aluminate (such as aluminate of lead) and some silicious substance.

TABLE *of the Hardness, Specific Gravity, and Refractive Power of the principal* GEMS *and* PRECIOUS STONES, *and some other* MINERALS; *compiled expressly for this work.*

Name.	Relative Hardness.	Specific Gravity.	Index of Refraction.
Agate	12	2·6	
Amethyst (Occidental)	11	2·7	
Calcareous spar	6	2·7	
Chalk	3	2·7	
Chrysolite	10	3·7	
Cornelian	11	2·7	
Crystal	11	2·6	
Diamond (bluish)	19	3·3	
„ (cubic)	18	3·2	
„ (from Ormuz)	20	3·7	
„ (pink)	19	3·4	2·439
„ (yellowish)	19	3·3	
„ (average colourless)	19 to 20	3·3 to 3·55	
Emerald	12	2·8	
Fluor-spar	7	3·5	1·434
Garnet	12	4·4	1·815
Glass	various	2·3 to 3·62	1·525 to 2·028
„ (crystal or flint)	various	3·0 „ 3·6	1·830 „ 2·028
„ (plate)	various	2·5 „ 2·6	1·514 „ 1·542
Gypsum	5	2·3	
Jasper (green)	11	2·7	
„ (reddish yellow)	9	2·6	
Onyx	12	2·6	
Opal	10	2·6	
Quartz	10	2·7	1·548
Ruby	17	4·2	1·779
„ (pale, from Brazil)	17	3·5	
„ (spinelle)	13	3·4	1·764
Sapphire (deep blue)	16	3·8	1·794
„ (paler)	17	3·8	
Sardonyx	12	2·6	
Schoerl	10	3·6	
Topaz	15	4·2	
„ (Bohemian)	11	2·8	
„ (whitish)	14	3·5	
Tourmaline	10	3·0	
Zeolite	8	2·1	
Zircon	—	—	1·961

The silica is found to unite with the lead, and to liberate the alumina in the crystalline form. When equal weights of alumina and red-lead are heated together in a crucible made of some refractory silicious substance, and maintained sufficiently long at a high temperature, there is found in the crucible, at the end of the operation, a layer of silicate of lead, and very frequently another of pure crystallised alumina or corundum.

The ruby colour is given by adding to the mixture in the crucible 2% or 3% of bichromate of potash; the blue is produced by the addition of a small quantity of oxide of cobalt, with a trace only of bichromate of potash. A film of silicate of lead very frequently adheres to the ruby crystals, and this has to be removed.

In some instances, however, the crystals formed are nearly pure, and are precisely similar to the natural gems in crystalline form, composition, hardness, and lustre.

Upon being heated, the artificial ruby, like the natural one, loses its rose colour, and recovers it again on cooling. It is said that the artificial gems hitherto obtained are not, as a rule, equal in lustre to the natural ones, and are consequently not so well suited for jeweller's work; also that they do not present to the lapidary conditions favourable to cleavage or cutting. They are, however, very well adapted for the works of watches. See ENAMELS, PASTES, &c.

GENE′VA. See GIN and HOLLANDS.

GEN′TIANIN. *Syn.* GENTIANINE; GENTIANINA, L. A substance obtained by MM. Henry and Caventou from the root of common gentian.

Prep. 1. Gentian root (in powder) is digested for 2 or 3 days in cold ether, with agitation, and the filtered tincture evaporated to dryness; the residuum is dissolved in rectified spirit, and the solution is again evaporated; the semi-crystalline mass is, lastly, redissolved in either alcohol or ether, and crystallised by careful evaporation.

2. (*Magendie.*) The ethereal extract is exhausted with cold alcohol (rectified spirit), as before, and the resulting tincture is evaporated to dryness; the residuum is dissolved in water, calcined magnesia added in excess, and the whole boiled and filtered; the sediment is digested in ether, and the ethereal tincture allowed to crystallise by slow evaporation.

Prop., &c. Gentianin forms golden-yellow needles, scarcely soluble in cold water, but very soluble in alcohol and ether. It is a powerful bitter and stomachic.—*Dose*, ½ gr. to 2 gr.

GEN′TIAN ROOT. *Syn.* GENTIANÆ RADIX, L. The dried root of *Gentiana lutea*, or 'yellow gentian.'—*Dose*, 10 to 30 gr.; as a simple bitter tonic and stomachic in dyspepsia, loss of appetite, gout, &c. It was formerly a favourite remedy in agues. "Joined with galls or tormentil, and given in sufficient quantity, it has not failed in any intermittents in which I have tried it" (*Dr Cullen*). In excessive doses it is apt to relax the bowels and disturb the system. When taken for some time it imparts its bitter flavour to the perspiration and urine. See DECOCTION, EXTRACT, &c.

GERMAN PASTE. *Prep.* From pea-meal, 2 lbs.; sweet almonds (blanched), 1 lb.; fresh butter or lard, ¼ lb.; moist sugar, 5 oz.; hay-saffron, ½ dr.; beat to a smooth paste, adding cold water, q. s.; granulate the mass by passing it through a colander, and expose the product to the air in a

warm place, until quite hard and dry. The addition of 2 or 3 eggs improves it. Used to feed larks, nightingales, and other insectivorous birds. It will keep good for twelve months in a dry place.

GER'MAN SILVER. *Syn.* ALBATA, ARGENTAN, ELECTRUM, NICKEL SILVER, TUTENAG, VIRGINIAN PLATE, WHITE COPPER. A well-known alloy, the finer varieties of which nearly equal silver in whiteness and susceptibility of receiving a high polish, whilst they surpass it in hardness and durability.

Prep. *a.* Zinc, copper, and nickel are put into a crucible in such a manner that copper is at the bottom as well as the top, while a layer of powdered charcoal covers the whole. The metals are then heated to fusion, and the mass stirred with an iron rod.

German silver is not readily acted upon by vinegar and the ordinary acids in culinary use, and is therefore used for spoons and forks. Average German silver consists of—

Copper . . .	50% to 66%
Zinc . . .	19% ,, 31%
Nickel . . .	13% ,, 18·5%

At Sheffield the following varieties of this alloy are made:

	Copper.	Nickel.	Zinc.
Common . .	8 . .	2 . .	3·5
White . . .	8 . .	2 . .	3·5
Electrum . .	8 . .	4 . .	3·5
Infusible . .	8 . .	6 . .	3·5
Tutenag . .	3 . .	3 . .	6·5

b. When the metal has all dissolved, the excess of acid is expelled by heating, the solution is diluted with distilled water, and hydrochloric acid is added; if any silver is present it is precipitated as silver chloride, which is filtered off, dried, and weighed.

c. The filtered liquid (see *b*) is next treated with a stream of sulphuretted hydrogen, and the black precipitate is collected, washed, and digested in strong nitric acid; when the solution is complete, sulphuric acid is dropped in to precipitate the lead (if any be present); if a precipitate is formed, the whole is evaporated to dryness, and the excess of sulphuric acid expelled by a rather strong heat applied towards the end; the dry mass is now collected on a filter, washed with a mixture of water and alcohol, dried, and exposed to slight ignition in a porcelain crucible.

d. The liquor filtered from the sulphate of lead, or (in its absence) the nitric solution of the precipitate produced by the sulphuretted hydrogen (see *c*), is next treated with potash, and the precipitated cupric oxide is filtered off, dried, and weighed.

e. The liquid which was filtered from the precipitate produced by the sulphuretted hydrogen (see *c*) is boiled to expel the excess of this gas, and is then precipitated with carbonate of soda in slight excess, and again boiled for a few minutes; the precipitate (mixed oxides of nickel and zinc) is collected, washed, and redissolved in dilute acetic or nitric acid in excess; a current of sulphuretted hydrogen is next passed through the solution, the precipitate collected on a filter, washed, redissolved in hydrochloric acid, and the solution again treated with carbonate of soda; the last precipitate (oxide of zinc) is washed, dried, and gently ignited.

f. The washings of the precipitated oxides and the liquid filtered from the precipitate occasioned by the sulphuretted hydrogen (see *e*) are mixed together, pure solution of ammonia added in considerable excess, and the mixture agitated for some time; the undissolved portion of the precipitate is then collected on a filter, washed with distilled water, redissolved in dilute nitric acid, again precipitated with solution of potash, and this last precipitate (ferric oxide) washed, dried, ignited, and weighed.

g. The ammoniacal solution filtered from the precipitate of sesquioxide of iron (see *f*) is precipitated with pure solution of potash, boiled for a few minutes, and, when cold, poured on to a filter; the precipitate (nickel oxide) is, lastly, washed with hot water, dried, ignited, and weighed.

Obs. The manufacture of nickel or German silver has acquired an importance which is second only to that of silver plate itself.

GER'MAN TINDER. See AMADOU.

GERMINA'TION. The growth or vegetation of a seed by which a young plant is produced. The conditions essential to germination are the presence of warmth, air, and moisture. The most favourable temperature is between 60° and 85° F., according to the habitat of the respective plants. Below 40° F. most of the more perfect seeds either refuse to vegetate, or vegetate slowly and feebly; and at or near the freezing-point none of them undergo this change. At a temperature above 100° F. the young germ is usually injured, and at about 125° F., if it forms, it soon withers and dies.

GERMS. See BACTERIA AS ORIGINATORS OF DISEASE.

GHEE. A sort of butter used by the natives of India. *Prep.* Milk is boiled in large earthen pots for an hour or two, then allowed to cool, a little curdled milk called 'dhye' being added, in order to make the whole coagulate. After a lapse of some hours the contents of each to the depth of 5 in. or 6 in. are removed and placed in a larger earthenware utensil, in which they are churned by means of a piece of split bamboo for about half an hour; then hot water is poured in, and the churning continued for ½ hour longer, after which time the butter is found to be formed. When this becomes rancid, it is melted in an earthen vessel, and boiled until all the water has evaporated; after which a little salt or betel-leaf is put into it; and finally it is poured off into suitable vessels, in which it can be preserved from the air. Bottles are commonly used for this purpose. See BUTTER.

GHER'KINS. *Syn.* GIR'KINS. Small cucumbers adapted for pickling. See PICKLES.

GILD'ING. *Syn.* DORURE, Fr. The art or process of covering the surfaces of bodies with a thin film of gold, for the purpose of increasing their durability or improving their appearance. For the sake of brevity we shall briefly notice the leading varieties of gilding and their applications in alphabetical order.

GILDING, BURNISHED. This is distemper gilding to which a 'face' has been given with

the 'burnisher.' It is chiefly employed for the polished portions of the frames of pictures and mirrors, the more prominent parts of statuettes, &c.

GILDING, CHEMICAL. Those varieties in which the film of gold is formed on the surface through the agency of chemical affinity, in opposition to mechanical gilding, in which the gold is made to adhere by the intervention of some glutinous substance.

GILDING, COLD. The articles (copper or brass) to be gilded, after being softened, annealed, and polished in the usual manner, are rubbed with a little gilding powder by means of a piece of cork moistened with a solution of salt in water; after which the work is burnished with a piece of hematite or polished steel (see *below*).

GILDING, DISTEMPER. This is applied to wood, plaster, marble, &c. It is commonly performed in this country by giving the wood, first, a coating of good size, and next, several successive coats of size thickened with finely powdered whiting, Spanish white, or plaster of Paris until a good face is produced; observing to let each coat become quite dry, and to rub it perfectly smooth with fine glass-paper, before the application of the following one. When the proper 'face' is obtained, the surface is thinly and evenly gone over with gold size, and when this is nearly dry, the gold leaf is applied, and afterwards burnished with an agate or dog's tooth. The process, as adopted by the Parisian artists, who greatly excel in this species of gilding, is very complicated, and is divided into at least 17 distinct operations, each of which they declare to be essential to its excellence.

GILDING, ELECTRO-. See ELECTROTYPE.

GILDING, GRECIAN. In this variety sal-ammoniac and corrosive sublimate, equal parts, are dissolved in nitric acid and a solution of gold made with this menstruum; after slight concentration the liquid is applied to the surface of silver, which immediately becomes black, but on being heated exhibits a rich gilded surface.

GILDING, JAPANNER'S. The surface is covered with oil size thinned with spirits of turpentine, and gold, in powder, is gently dabbed on with a puff of wash-leather. This gives the appearance of 'frosted gold.' A coating of varnish is next given, followed by exposure to a gentle heat in the 'stove.'

GILDING, LEAF. This term is commonly applied to the gilding of paper, vellum, &c., by applying leaf-gold to the surface, previously prepared with a coating of gum-water, size, or white of egg. It is usually burnished with an agate or dog's tooth.

GILDING, MECHANICAL. See CHEMICAL GILDING (*above*).

GILDING, MERCURIAL. See WASH-GILDING (*below*).

GILDING, OIL. This species of gilding may be divided into several operations. The following are the abridged instructions of a Parisian artist on the subject:—1. The surface is prepared by a coating of white-lead in drying oil. 2. Another coat is given, made with calcined white-lead or massicot, ground in linseed oil and turpentine. Three or 4 coats of this mixture are often given, at intervals of at least 23 hours, observing to carefully smooth off each coat with pumice-stone or shave-grass before the application of the following ones. 3. The 'Gold Colour,' or paint, is next applied. It is usually very adhesive gold size, or the bottom of the pot or dish in which painters wash their brushes. For this purpose it is thoroughly ground and strained. 4. When the gold colour becomes partially dry and sufficiently tenacious the gold-leaf is applied, and pressed on with a wad of cotton wool or a soft brush. It is now left for several days to harden. 5. A coat of spirit varnish is next given, and the object is cautiously passed over a chafing-dish of charcoal, observing to avoid stopping the motion of the piece whilst doing so, as the work would then become discoloured and blistered. 6. The work is 'finished off' with pale oil varnish. For outdoor gilding and common work the varnishing process is generally omitted. This species of gilding is applied to woodwork, plaster, metal, &c.

GILDING, VARNISH. This is a mere variety of oil-gilding, applied to equipages, furniture, mirror and picture frames, &c., the surface being highly varnished and polished before it receives the size or gold colour; and after the gilding has become quite dry a coat of spirit varnish, fumed with the chafing-dish as above, is applied, followed by 2, 3, or more coats of the best copal varnish, at intervals of 3 or 4 days each. The whole is, lastly, carefully polished with tripoli and water.

GILDING, WASH-, AMALGAM G., MERCURIAL G., WATER-G. This consists in the application of a thin coating of amalgam of gold to the metallic surface (brass, bronze, or copper) to be gilded, and the subsequent volatilisation of the mercury by heat. It is the usual method of gilding articles of copper and its alloys, and possesses great beauty and durability when skilfully executed. The occupation is, however, an unhealthy one, owing to the continual exposure of the workman to the fumes of mercury. The furnace invented by M. D'Arcet obviates this evil, as the whole of the volatilised mercury is carried off, and again condensed for further use. It should, therefore, be adopted by every water-gilder who studies economy and the health of those in his employ.

The process of water-gilding consists in several distinct operations, and can only be successfully performed by those who have been schooled in the art by an apprenticeship to the trade. It would, therefore, be waste of space to enter into details here. Formulæ for several of the articles employed for the purpose will be found in their alphabetical places in this work.

GILDING, WATER-. See *above*.

Among the applications of the process of gilding that deserve a separate notice are the following:

The gold letters and figures on the covers of BOOKS are thus formed:—Gum-mastic, in fine powder, is dusted over the surface to be gilded; an iron or brass tool bearing the design upon its face is then heated to a proper temperature, and gently pressed upon a piece of leaf-gold which slightly adheres to it; the two are then transferred to the cover, and the tool is gently pressed on it, by which means the mastic softens and retains the gold. The loose gold and powdered mastic are then dusted off with a brush. Gold

leaf will adhere to leather without the use of mastic, but not so firmly as when it is employed.

The edges of the leaves of books and paper are first cut perfectly smooth, and then washed over with a solution of isinglass in weak spirit, or with a varnish made of Armenian bole, 4 parts, and powdered sugar-candy, 1 part, mixed up to a proper consistence with strained white of egg. The coating is allowed to dry, and is then smoothed with a wet rag, after which the gold leaf is applied and polished with the burnisher.

BRASS BUTTONS, formerly so much in demand, are covered by a rough species of wash-gilding. The buttons are polished in the lathe and thrown into a pan with a little amalgam of gold, and as much aquafortis diluted with water as will wet them all over. Here they are well stirred up, until they assume a silvery appearance, when they are washed with clean water. They are then submitted to a sufficient heat in a suitable apparatus, until the mercury is volatilised. The buttons are next cooled, and well tossed and rubbed about with a painter's brush; and are, lastly, burnished by washing them well with beer or ale grounds.

Twelve dozen (1 gross) of buttons, of 1 inch in diameter, may be perfectly gilded on both sides with only 5 gr. of gold. By an Act of Parliament, which is still unrepealed, this is the smallest quantity of gold permitted to be used for a gross of buttons of the above size.

GLASS, PORCELAIN, and EARTHENWARE are gilded by blending powdered gold with gum-water and a little borax, and applying the mixture by means of a camel-hair pencil; the article is then heated in an oven or furnace, by which means the gum is burnt, and the borax, vitrifying, cements the gold to the surface. It is afterwards polished with a burnisher. Names, dates, or any fancy device may thus be permanently and easily fixed on glass, china, earthenware, &c.

JAPANNED WORK is gilded by the method explained as 'Japanner's gilding' (*above*).

LEATHER is gilded in the same way as the covers of books (see *above*). For common work, silver leaf, or even tinfoil, is applied to the surface, previously covered with size or white of egg, and after being burnished down and dried, is washed over with gold-coloured lacquer.

The LETTERS of sign-boards and the ornamental gilding for outdoor work are done by first covering the design with yellow paint, then with oil gold-size, and when this is nearly dry applying the leaf-gold, observing to shield it properly from the wind, lest it be blown away or become crumpled before being properly attached. The work is, lastly, varnished.

POLISHED METALS may be gilded by one or other of the methods already noticed. Articles in silver, copper, brass, and bronze are usually coated by the process of wash or water gilding; or, directly, by the application of gold leaf, as follows:—The piece or article is heated to a bluish tint, and gold leaf pressed gently and carefully on it with the burnisher; heat is again applied, and the process repeated with fresh leaves of gold until the gilding has acquired the proper thickness and tone. The surface is lastly polished with the burnisher, or is coloured in the usual manner at the stove. This succeeds with iron, steel, silver, copper, and its alloys, &c. Another method for polished articles in iron and steel, which, however, is less durable than the preceding, is to apply an ethereal solution of gold to the surface with a camel-hair pencil. The ether evaporates and leaves the surface coated with gold, which is then polished as before. In this way any fancy device or writing may be executed on steel or iron with extreme facility.

SILKS, SATINS, WOOLLENS, IVORY, BONE, &c., may be readily gilded by immersing them in a solution of neutral terchloride of gold (1 of the salt, and 3 to 6 of water), and then exposing them to the action of hydrogen gas. The latter part of the process may readily be performed by pouring some dilute sulphuric acid on zinc or iron filings, in a wide-mouthed bottle, and placing it under a jar or similar vessel inverted, at the top of which the articles to be gilded are suspended. Flowers or other ornamental designs may be produced by painting them on the surface with a camel-hair pencil dipped in the solution. The design, after a few minutes' exposure to the hydrogen, shines with all the splendour of the purest gold, and will not tarnish on exposure to the air or in washing.

GILDED THREAD or GOLD THREAD is merely a thread of yellow silk covered with a very thin flatted wire of gold by means of a revolving wheel.

WIRE (copper, silver, or brass) is occasionally gilded, in coils, by a similar process to that adopted for BUTTONS; but more frequently as follows:—Rods (usually of silver) are covered with gold foil of a thickness proportionate to the quality of the intended wire, and the compound bar is then drawn into wire in the usual way. 100 gr. of gold was formerly the lowest legal quantity that could be employed for 1 lb. of silver.

Patents. Among the varieties of chemical gilding may be mentioned—

1. (*Elkington's* Patent — GERMAN GILDING, *Bonnet's* GILDING PROCESS.) The articles to be gilded, after being perfectly cleaned from scale or grease, and receiving a proper 'face,' are suspended, by means of wires, in the gilding liquid (boiling hot), and moved about therein for a period varying from a few seconds to a minute, or longer; the precise time required depending on the newness and strength of the liquid. When sufficiently gilded the articles are withdrawn from the 'solution of gold,' washed in clean water, and dried; after which they undergo the usual operation of 'colouring,' &c. A dead-gold appearance is produced by the application to the articles of a weak solution of nitrate of mercury previously to the immersion in the gilding liquor, or the deadening may be given by applying a solution of the nitrate to the newly gilded surface, and then expelling the mercury by heat.

The Gilding Liquor. Take of fine gold, 5 oz. (troy); nitro-muriatic acid, 54 oz. (avoirdupois); dissolve by heat, and continue the heat until red or yellow vapours cease to be evolved; decant the clear liquid into a suitable vessel; add of distilled water, 4 galls.; pure bicarbonate of potassa,

20 lbs.; and boil for 2 hours. The nitro-muriatic acid is made with pure nitric acid (sp. gr. 1·45), 21 oz.; pure muriatic acid (sp. gr. 1·15), 17 oz.; and distilled water, 14 oz.

This process, though patented by Mr Elkington in England, was in reality discovered and first practised by M. Bonnet, a foreigner. Articles thus gilded do not bear friction and the operations of being put in colour (*mise en couleur*) so well as those gilded by the mercurial process, or by the methods of cold or leaf-gilding as applied to polished metals.

2. (*Talbot's* Patent.) By this process polished metallic articles are gilded by simple immersion in a solution of gallic acid in water, ether, or alcohol, to which a solution of gold has been previously added. SILVERING and PLATINISING may be effected in the same manner by using a solution of either of these metals instead of one of gold.

*** These and other chemical processes have been almost completely superseded by the certain and economical process of ELECTRO-GILDING. See ELECTROTYPE.

Gilding Amalgam. See AMALGAM.

Gilding Liquor. This name has been given to various solutions of gold, and to other liquids employed in gilding. The former are noticed elsewhere. Among the latter are the following:

DEADING AQUAFORTIS. From mercury, 1 part; aquafortis (sp. gr. 1·33), 3 parts; dissolve, and add of soft water, 7 parts. Used to produce a dead-gold effect. It is applied (diluted) to the articles, before spreading the amalgam over them, in water-gilding; or before placing them in the 'gilding liquor' in the chemical processes.

GILDER'S PICKLE. From alum and common salt, of each, 1 oz.; nitre, 2 oz.; dissolved in water, ½ pint. Used to impart a rich colour to gold surfaces, especially of trinkets. Its application should not be too long continued, as it dissolves a small portion of the gold. For common purposes it is best used largely diluted with water.

MERCURIAL SOLUTION. From mercury, 10 parts; dissolved in aquafortis (sp. gr. 1·33), 11 parts, and the solution diluted with 25 times its weight of water. Used to moisten the scratch brush before drawing it over the amalgam, in mercurial gilding; also to deaden the gilded surface by moistening the latter with it, and then exposing the piece to a heat sufficiently high to drive off the mercury.

VERMEIL, VERMEIL COATING, OR-MOLU C. From annotta and salt of tartar, of each, 1 oz.; dragon's blood, ½ oz.; water, 1 quart; simmer down to about 1-4th, add saffron, 20 gr., and when merely tepid, strain through fine muslin into a bottle. Used to give lustre and fire to distemper gilding. A little is floated over the surface with a very soft flat camel-hair brush.

Gilding Metal. The metal employed as a base for gilding is usually brass, or a mixture of brass and copper. The following proportions have been recommended:

1. Copper, 6 parts; brass, 1 part.
2. Copper, 4 parts; Bristol brass, 1 part.
3. Copper, 13 parts; old Bristol brass, 3 parts; tin, 14 parts.

Gilding Powder. *Prep.* 1. Pure gold, 5 dr.; pure copper, 1 dr.; aqua regia, 10 oz.; dissolve, moisten clean linen rags with the solution, dry them, and burn them to ashes. The latter contain the gold in a state of minute division, and must be carefully collected.

2. Grain gold, 1 dr.; rose copper, 15 gr.; aqua regia, 2 fl. oz.; proceed as last. Used in 'Gold Gilding.'

3. See GOLD (in powder).

Gilding Shells. See GOLD SHELLS.

Gilding Size. See GOLD SIZE.

Gilding Wax. *Syn.* GILDING VARNISH, GILDER'S WAX. *Prep.* 1. From beeswax, 4 oz.; verdigris and sulphate of copper, of each, 1 oz.; melted together.

2. Beeswax, 4 oz.; verdigris, red ochre, and alum, of each, 1 oz. Used to give a red gold colour to water-gilding.

GIN. *Syn.* GENEVA. Corn-spirit flavoured with either oil of juniper or oil of turpentine.

Gin was originally, and for some time wholly, imported from Holland, and was a rich, soft spirit, flavoured chiefly with juniper berries; on which account it has obtained the name of 'GENEVA,' from 'GENIÈVRE,' the French for juniper. After a time the distillation of an imitation geneva sprung up in this country, when the foreign spirit came to be called 'HOLLANDS,' or 'HOLLANDS GENEVA,' to distinguish it from the spirit of home manufacture. The English monosyllable 'GIN' is a corruption of geneva, the primary syllable of which, as in numerous other instances, was seized on by the vulgar, and adopted as a short and convenient substitute for the whole word.

The liquor at present known by the name of 'gin' in this country is a very different article from that imported from Holland, and consists of plain corn-spirit, flavoured with oil of turpentine and small quantities of certain aromatics. The thousand-and-one receipts for this article, which have from time to time been printed in books, produce a flavoured spirit bearing no resemblance to the more esteemed samples of English gin; and, if possible, the products are even more unlike genuine Hollands. Any person may easily satisfy himself of the truth of this assertion by actual experiment on the small scale. The cause of this incongruity has arisen chiefly from the writers not being practically acquainted with the subject, and from the disinclination of well-informed practical men to divulge, gratuitously, what they conceive to be valuable secrets. Hence the utter failure of any attempts to produce either gin or Hollands from the receipts usually published. In practice, it is found that the true flavour of foreign geneva cannot be imparted to spirit by juniper alone, and that the English gin of the present day depends for its flavour on no such a substance. The following formulæ are merely given as specimens; and it is proper to remark that every distiller has his own receipt for this beverage. Hence it is that the gins of no two distillers are of precisely the same flavour; and this difference is still more marked when the distillers reside in parts of the country remote from each other. Booth's, Smith's, and Nicholson's gins have each a characteristic flavour, readily perceived by their respective votaries;

whilst the difference between 'Plymouth' or 'Bristol gin,' and the 'gin of the metropolis,' is as remarkable as that between 'Barclay's XXX' and 'Guinness's bottled stout.' These variations in flavour generally depend on the use of more or less flavouring matter, or of a spirit more or less clean or free from taint; and, less frequently, on the addition of a small quantity of some peculiar aromatic, which exercises a modifying influence on the chief flavouring ingredient. In many cases the flavour has originated from accident, but the consumers having become accustomed to, and hence relishing, that particular 'palate,' it is found to be unwise or commercially impossible to alter it.

In the preparation of gin, both sweetened and unsweetened, and indeed of liqueurs generally, the greatest possible care must be taken to avoid an excess of flavouring. The most esteemed samples are those that consist of very pure spirit, slightly flavoured.

Prep. 1. Clean corn-spirit, at proof, 80 galls.; newly rectified oil of turpentine, $1\frac{1}{4}$ pints; mix well by violent agitation; add culinary salt, 14 lbs., dissolved in water, 40 galls.; again well agitate, and distil over 100 galls., or until the faints begin to rise.—*Prod.*, 100 galls. of gin 22 u. p., besides 2 galls. contained in the faints. If 100 galls. 17 u. p. are required, 85 galls. of proof spirit, or its equivalent at any other strength, must be employed.

2. Proof spirit (as *above*), 8 galls.; oil of turpentine, 1 fl. oz.; salt, $1\frac{1}{2}$ lbs., dissolved in water, 4 galls.; draw over 10 galls., as before. 22 u. p.

3. Clean corn-spirit, 80 galls.; oil of turpentine, 1 pint; pure oil of juniper, 3 fl. oz.; salt, 21 lbs.; water, 35 galls.; draw over 100 galls., as before. 22 u. p.

4. To the last, before distillation, add, of oil of caraway, $\frac{1}{2}$ fl. oz.; oil of sweet fennel, $\frac{1}{4}$ fl. oz.; cardamoms (ground), 8 oz.

5. To No. 3 add of essential oil of almonds, 1 dr.; essence of lemon, 4 oz.

6. To No. 1, before distillation, add of creosote, 3 fl. dr.

7. To No. 3 add of creosote, 2 dr.

8. Proof spirit, 80 galls.; oil of turpentine, $\frac{3}{4}$ pint; oil of juniper, $\frac{1}{4}$ pint; creosote, 2 dr.; oranges and lemons, sliced, of each, 9 in number; macerate for a week, and distil 100 galls. 22 u. p.

9. To No. 1 add of rectified fusel oil, $\frac{1}{2}$ pint.

10. To No. 1 add of oil of juniper, $\frac{1}{2}$ pint.

Concluding Remarks. The oil of turpentine for this purpose should be of the best quality, and not that usually vended for painting, which always contains resin and often fixed oils. Juniper berries, bitter almonds, and the aromatic seeds may be used instead of the essential oils; but the latter are the most convenient. Turpentine conveys a plain-gin flavour; juniper berries or oil gives a Hollands flavour; creosote imparts a certain degree of smokiness or whisky flavour; lemon and other aromatics, a creaminess, fulness, and richness. The flavour imparted by cardamoms, when used judiciously, is peculiarly agreeable and appropriate. That from caraways is also in general esteem. Cassia in extremely small proportions also tells well. Fusel oil gives a whisky-gin flavour; and in conjunction with creosote or crude pyroligneous acid, a full whisky flavour. The only danger in the employment of all these articles is using too much of them. When this misfortune happens, the remedy is to add sufficient plain spirit to reduce the flavour to the proper standard. The creaminess and smoothness so much admired in 'foreign geneva' results chiefly from age. The English rectifier endeavours to imitate this by the addition of a little sugar. A rich mellowness that combines well with gins turning on the 'Hollands flavour,' is given by a very small quantity of garlic, and with Canadian balsam or Strasburg turpentine. The peculiar piquancy, or the property of 'biting the palate,' regarded as a proof of strength and quality by the ignorant gin-drinker, is imparted to the liquor by the addition of a little caustic potassa. Sliced horseradish gives piquancy as well as mellowness. Grains of paradise, cayenne pepper, and sulphate of zinc are also commonly added by fraudulent dealers.

Although gin is always prepared on the large scale by distillation, it may also be made by the simple solution or digestion of the flavouring ingredients in the spirit; but it is, of course, better for distillation. If made in the former way, no salt must be employed. The gin produced by the above formulæ is that denominated in the trade 'UNSWEETENED GIN,' 'GROG GIN,' &c.; but the gin usually sold in the metropolis is a sweetened spirit, and hence is technically distinguished by the term 'SWEETENED,' or 'MADE-UP.' The generality of London gin-drinkers prefer the latter article, even when weaker and inferior, which it usually is, as the addition of sugar permits adulteration and watering to an enormous extent with absolute impunity. Sweetened spirit cannot be easily tested for its strength, and is taken by the Excise at the strength which it is declared to possess by the dealer. To ascertain whether gin is sweetened or not, a little may be evaporated in a spoon over a hot coal or a candle, when, if it is pure, it will leave the spoon scarcely soiled; but if, on the contrary, it has been sweetened, a small quantity of syrupy liquid or sugar will be obtained, the sweetness of which may be easily recognised by tasting it.

The whole of the casks and utensils employed for gin should be perfectly clean, and properly prepared, so as not to give colour; as, if this spirit acquires the palest coloured tint, its value is lessened, and if much coloured it is rendered unsaleable. When gin has once become much stained the only remedy is to re-distil it; when it is only slightly stained, the addition of a few lbs. of acetic acid (B. P.) to a pipe or butt, a spoonful or two to a gallon, or a few drops to a decanter-full, will usually decolour it, either at once or as soon as it is mixed with water, to make grog. See ALCOHOLOMETRY, CASKS, DISTILLATION, HOLLANDS, SPIRITS, &c., and *below*.

Gin, Cordial. This is gin sweetened with sugar and slightly aromatised.

Prep. Good gin (22 u. p.), 90 galls.; oil of almonds, 1 dr.; oils of cassia, nutmeg, and lemon, of each, 2 dr.; oils of juniper, caraway, and coriander, of each, 3 dr.; essences of orris root and cardamoms, of each, 5 fl. oz.; orange-flower water,

3 pints; lump sugar, 56 to 60 lbs.; dissolved in water, 4 galls. The essences are dissolved in 2 quarts spirit of wine, and added gradually to the gin until the requisite flavour is produced, when the sugar (dissolved) is mixed in, along with a sufficient quantity of soft water, holding 4 oz. of alum in solution to make up 100 galls. When the whole is perfectly mixed, 2 oz. of salt of tartar, dissolved in 2 or 3 quarts of hot water, are added, and the liquor is again well rummaged up; after which the cask is bunged up and allowed to repose. In a week, or less, it will have become brilliant, and may be either 'racked,' or drawn from the same cask.—*Prod.*, 100 galls., about 30 u. p.

Gin, Sweetened. *Prep.* From unsweetened gin (22 u.p.), 95 galls.; lump sugar, 40 to 45 lbs., dissolved in clear water, 3 galls.; mix well, and fine it down as above.—*Prod.*, 100 galls., at 26 u. p. This, as well as the last, is usually 'permitted' at 22 or 24 u. p., which is also done when the gin has been further lowered with water, so as to be even 30 or 35 u. p. See SPIRIT, and *above.*

GIN'GER. *Syn.* GINGER ROOT; ZINGIBERIS RADIX, ZINGIBER (B. P.), L. "The scraped and dried rhizome" (rootstock or underground stem) of *Zingiber officinale* (B. P.). Ginger is an aromatic stimulant and stomachic, very useful in flatulence and spasms of the stomach and bowels, and in loss of appetite and dyspepsia, arising from debility, or occurring in old or gouty subjects. A piece chewed an hour before dinner tends to provoke the appetite; as a masticatory, it often relieves toothache, relaxation of the uvula, tender gums, and paralytic affections of the tongue. Made into a paste with warm water, and spread on paper, it forms a useful and simple 'headache plaster,' which frequently gives relief when applied to the forehead or temples. As a condiment and flavouring ingredient, it is perhaps one of the most wholesome of the aromatic kinds, and is less acrid than the peppers.—*Dose,* 10 gr. to ½ teaspoonful, stirred up in any simple liquid.

Pur., &c. The best is that known in commerce as 'UNBLEACHED JAMAICA GINGER,' which is an uncoated pale variety, occurring in large, bold, fleshy pieces ('RACES'), which cut soft, bright, and pale-coloured. The inferior varieties occur in smaller pieces, and are darker coloured, flinty, and shrivelled. The dealers frequently 'dress up' the common dark-coloured gingers by washing them in water, drying them, and then 'rouncing' them in a bag with a little calcined whiting or magnesia (WASHED GINGER); or they bleach them by dipping them into a solution of chloride of lime, or by exposing them to the fumes of burning sulphur (BLEACHED GINGER); or they dip them into a milk formed of quicklime or whiting and water (WHITEWASHED GINGER). The last has a chalk-white surface, which cannot be mistaken for the natural one. POWDERED GINGER is with difficulty obtained pure and good. The common adulterants are wheat-flour, or East Indian arrowroot, and plantain-meal. The first may be detected by the microscope, the others by the flavour and action of hot water. See LOZENGES, &c.

Ginger Ale. The first point is to select a good sound unbleached ginger; Jamaica may be preferred, although a fair sample of Cochin yields a very good extract. The great aim is, as far as possible, to ensure the freshness of the root, as ginger loses a considerable amount of its peculiar odour, although its pungency remains almost unchanged, by long keeping. The extract is prepared by pounding 20 oz. of the root into a coarse powder, which should be rendered uniform by passing it through a sieve of forty meshes to the inch; the granules thus obtained are mixed with a sufficient quantity of dilute spirit, composed of equal parts of alcohol at 60°, and distilled water, so as to form a paste, which is placed in a percolating apparatus, and left to macerate for 48 hours. Next pour on dilute spirit, so as to obtain 70 oz. of tincture; press out the marc strongly, and finally add sufficient liquid to make up 80 oz.

Of the tincture thus prepared take 7 oz.; mix with 6 pints of water and sufficient kaolin (China clay), or thoroughly washed whiting may be used; filter through paper so as to obtain a perfectly bright filtrate, in which dissolve 6 lbs. of sugar without heat. This quantity will be found easily soluble in the above proportion of water.

This forms the first part of the process, which is completed by the addition of 140 drops of tincture of capsicum berries (obtained by macerating 8 oz. of the bruised berries with 25 oz. alcohol at 60°, and 25 oz. distilled water, and proceed as in making the essence of ginger; the product should measure 50 oz.); also 180 drops tincture of vanilla (made by macerating 1 oz. vanilla pods, thoroughly bruised in a mortar, with 2 oz. distilled water and 8 oz. alcohol at 60° for 8 days); also 6 drops essence of cloves (essential oil of cloves, 1 part; alcohol at 60°, 9 parts) with 30 drops essence of lemon, which quantity will be found perfectly soluble in the syrup, providing that the quality is good; and 2 oz. of citric acid dissolved in 6 oz. of water.

The syrup thus completed may be coloured by the addition of burnt sugar as required, and finally filtered with a little paper pulp in the usual way; 1½ oz. is the requisite quantity for each bottle. If it is deemed necessary to give an extra amount of foam, more than exists naturally in the ginger, a most efficient heading may be obtained from the following formula:—Soapwort root (*Saponaria officinalis*), in coarse powder, 4 oz.; animal charcoal, 2 oz. Macerate 2 days in a mixture of alcohol, 60°, 4 oz.; pure glycerine, 4 oz.; distilled water, 8 oz.; then percolate so as to obtain 16 oz. of finished extract. Two drachms of this will be found sufficient for 1 gall. of syrup ('Mineral Water Trade Review').

Gin'ger Beer. See BEER.

Ginger Beer Plant. This plant is kept by people in country places, who use it for making a drink. For this purpose they dissolve about 1 oz. of sugar in a pint of water; the plant is then put in, multiplies greatly in the solution, breaking it up into alcohol and carbonic acid, and the result is an effervescing drink. The ginger beer plant is in reality a heterogeneous mixture of various Torulæ and bacteria, some of which appear to occur together constantly in nature.

Ginger Brandy. Macerate ½ lb. of bruised Jamaica ginger in a gallon of brandy for a fortnight and strain. Now make a decoction of the ginger with a gallon of boiling water. Strain and dissolve 10 lbs. of sugar in the decoction; then add the brandy and finings to clear.

Ginger Essence (Soluble). Strong tincture of ginger, 2½ pints; water, 2½ pints; powdered alum, ½ oz. Shake occasionally for an hour or two, then filter and add to the filtrate ½ oz. of carbonate of magnesium. Shake well and filter again. Finally add 4 oz. of rectified spirit. The essence is soluble in 20 parts water, and is useful for making ginger ale.

Preserved Ginger. *Syn.* CONDITUM ZINGIBERIS, L. An excellent stomachic sweetmeat or preserve. It is chiefly imported from the West Indies and China. See CANDYING, &c.

A Factitious Preserved Ginger is sometimes met with, prepared from the stalks of lettuces just going to seed, using a concentrated syrup, strongly flavoured with Jamaica ginger. See CANDY, &c.

GIN'GERBREAD. *Prep.* 1. (*Dr Colquhoun.*) Flour, 1 lb.; carbonate of magnesia, ¼ oz.; mix; add of treacle, ½ lb.; moist sugar, ¼ lb.; melted butter, 2 oz.; tartaric acid (dissolved in a little water), 1 dr.; make a stiff dough, then add of powdered ginger and cinnamon (cassia), of each, 1 dr.; grated nutmeg, 1 oz.; set it aside for ½ hour or 1 hour before putting it into the oven.

Obs. It should not be kept longer than 2 or 3 hours at the utmost before being baked.

2. Flour and treacle, of each, 1 lb.; butter, 1½ oz.; carbonate of magnesia, 1 oz.; add spices (ginger, cinnamon, nutmeg, allspice, cayenne, corianders, &c.) to taste; mix as last.

Obs. Fit for baking in from 4 to 6 hours.

3. Flour, 2 lbs.; carbonate of magnesia, ½ oz.; mix; add treacle, 1½ lbs.; butter, 2 oz.; spice, q. s.; tartaric acid, ¼ oz.; mix quickly, and make it into forms.

Obs. Ripe for the oven in ½ to 1 hour.

4. Instead of tartaric acid in the last formula, use cream of tartar (dissolved in water), 2 oz.

Obs. Ripens in 40 or 50 minutes.

5. Flour or fine pollard, 1 lb.; treacle, ¾ lb.; salt of tartar, ½ oz., dissolved in water, q. s.; butter, 1 oz.; spices, to palate.

Obs. Takes several days to ripen; sometimes a fortnight.

6. (Extemporaneous.) *a.* From flour, 1¼ lbs.; moist sugar and treacle, of each, ½ lb.; butter, 2½ oz.; baker's salt (carbonate of ammonia), ¼ oz., dissolved in cold water, q. s.; ginger, 3 dr.; nutmeg, 2 dr.; cassia, 1 dr.; cayenne pepper (best), ½ dr.

b. From flour, 6 lbs.; powdered ginger, 2½ oz.; caraway seeds, 1 oz. (and other spices to palate); candied lemon and orange peels, of each, 2 oz.; moist sugar and melted butter, of each, ½ lb.; treacle, 4 lbs.; volatile salt, 2 oz.; water, q. s.; mix as above. May be baked at once.

c. From Jones's patent flour, 2 lbs.; treacle, 1 lb.; moist sugar, ¾ lb.; butter, 2½ oz.; spice, q. s.; mix as quickly as possible, and bake it instantly. If the dough is expertly mixed up, the quality of the product is fully equal, if not superior to that of any of the preceding formulæ.

Obs. Gingerbread is either rolled out into thin sheets and cut into cakes or nuts (GINGERBREAD NUTS) with the top of a wine-glass or canister, or is formed into thick cakes, which are baked in 'batches' (ordinary GINGERBREAD). Both varieties require a pretty brisk oven; the thinner kinds (nuts, &c.), especially, must be baked as crisp as possible, without being burnt. The varieties called LEMON GINGERBREAD, CARAWAY G., &c., have a perceptible predominance of these flavouring ingredients. The addition of a little alum, dissolved in water, makes the bread both lighter and crisper, and causes it to ripen quicker, but at the same time lessens its wholesomeness.

GIN'GER CAN'DY. See CANDYING.

GIN'GER DROPS. See DROPS (Confectionery).

GINGERIN. *Syn.* OLEORESINA ZINGIBERIS. *Prep.* (Pharm. U. S.) Put 1 lb. (troy) of ginger in fine powder into a percolator, and pour on it 12 oz. (old measure) of pure ether. When this has been absorbed, add rectified spirit until 12 oz. (old measure) have been obtained. Recover the greater part of the ether by distillation over a water-bath, and expose the residue in a porcelain dish until the volatile part has evaporated. Keep it in a stoppered bottle.

GINSENG. The root of the *Panax schinseng* (ginseng) is greatly esteemed in China, where it is regarded as a panacea for nearly all diseases, and where it realises a high price in consequence. This opinion of its therapeutic value is not shared by British and American practitioners, who look upon it as a comparatively inert substance. An allied species, the *Panax quinquefolium,* is sold in America, less for the sake of its very feeble demulcent properties than to supply the demand of those who have acquired a taste for it. "The root has a somewhat bitter taste, and is somewhat mucilaginous. It occurs in pieces usually about 3 in. or 4 in. long, often partially divided, being joined together at the base; when clean it has a semi-transparent appearance" ('Gardener's Chronicle').

Ordinary ginseng is prepared by simply drying the root in the sun, or over a charcoal fire. To make red or clarified ginseng, the root is placed in wicker baskets, which are put in a large earthenware vessel with a closely fitting cover, and pierced at the bottom with holes. It is then placed over boiling water, and steamed for about 4 hours.

Ginseng was for centuries regarded as a very elixir of life all over the East, and especially in China and Japan. Its properties were believed to be miraculous, but they were generally supposed to be confined to the Corean ginseng. Hence its enormous price, which put it out of the reach of all but the rich. The wild ginseng of Corea has frequently fetched 20 times its weight in silver in China. The export from Corea is a strict monopoly, which affords a considerable revenue, and is said to be the king's personal perquisite. Death is the punishment for smuggling it out of the country. The total export is only about 27,000 lbs.

GLAIRE. White of egg. See ALBUMEN and EGG.

GLAN'DERS. *Syn.* FARCINOMA, L. A contagious disease, generally confined to the horse, ass, and mule, but communicable to man, in whom

it assumes a highly malignant and often fatal character. This disease appears under two forms: 1, SIMPLE ACUTE GLANDERS, marked by copious discharge of foul mucous matter from the nostrils and adjacent parts; and 2, FARCY, FARCIN, or FARCY GLANDERS, when it attacks the lymphatics of the skin, either generally, producing a distended appearance of the vessels, like moles or buttons (LEAD OR BUTTON FARCY), or locally, when it takes the form of dropsical accumulations in the legs (WATER FARCY).

Glanders and farcy are one and the same disease manifesting itself in a slightly different manner.

Treatm. Mr Youatt considers it useless to attempt the cure of glandered horses; but that farcy in its earlier stages and milder forms may be often successfully treated. "All the mercurials have been used with benefit in farcy; but they must be discontinued as soon as the mouth is sufficiently affected, or sickness, loss of appetite, and like symptoms are produced" (*Blaine*).

The ointment of biniodide of mercury is often very useful as a local application to the swellings. Tonic remedies, iron, copper, and arsenic are useful, and Professor Williams strongly recommends 5-gr. doses of arsenious acid with 1 dr. of nux vomica for several days. Cleanliness, ample ventilation of stables, and good food seem to be the best preventives, and avoidance of all possible contact with affected animals. American veterinarians have great faith in sodium hyposulphite, giving 2 oz. of the salt with every meal. They say also that the sores require no treatment but cleanliness (*Williams*).

"Glanders is quite incurable, but by generous diet, good stabling, and mineral tonics, life, except in extremely acute cases, may be prolonged for many weeks. This, however, is not desirable; for it involves great risk, not only to other horses, but also to the attendants" (*Finlay Dun*).

GLASS. *Syn.* VITRUM, L. This well-known substance is essentially a mixture of silicates with an excess of silica. It may contain the silicates of soda, lime, baryta, magnesia, alumina, and lead, coloured by small portions of iron, manganese, cobalt, uranium, copper, or gold. In its usual form it is brittle, transparent, non-crystalline, insoluble, and fusible; but it sometimes exhibits other properties. The manufacture of glass is an invention of great beauty, and, considering the comparative worthlessness of the materials of which it is made, and the various purposes of a useful, ornamental, and scientific nature to which it is applied, it is doubtless one of the most important inventions of the age.

The different kinds of glass may be classified according to their chemical composition as follows:

1. Potash-lime, or Bohemian glass, is colourless, very difficultly fusible, and not easily acted upon by chemicals.

2. Soda-lime, French, or window glass, is more easily fusible than Bohemian glass, and is somewhat harder. Crown glass is of similar composition.

3. Potash-lead, or crystal glass, is easily fusible, has a high specific gravity, and is very refractive. It is used for optical and other purposes.

4. Alumina-lime-alkali, or bottle glass, always contains oxides of iron and manganese. The colour varies from a red-yellow to a deep black-green.

The variation in specific gravity may be seen in the following table:

Bohemian crystal glass	2·396 sp. gr.
Crown glass	2·487 ,,
Mirror glass	2·498 ,,
Window glass	2·642 ,,
Bottle glass	2·732 ,,
Lead glass	2·9 to 3·255 ,,

The refractive index of glass varies considerably, but is never so high as that of the diamond.

Raw Materials used in Glass-making. 1. Silica, viz. quartz or sand. Quartz is used only for very pure glass. Sand must always be ignited, and often has to be washed or treated with hydrochloric acid before use.

2. Potash and soda are used in a variety of forms, chiefly as impure carbonates.

3. Lime is employed as quicklime, or in the form of chalk.

4. Oxide of lead is used in the manufacture of lead-glass in the form of minium. The lead gives the glass a higher specific gravity, greater brittleness, transparency, and polish.

5. Braunite, arsenious acid, saltpetre, and red-lead are used for 'glass-clearing'—that is, to produce colourless glass.

6. Other substances sometimes used are boracic acid, oxide of zinc, oxide of bismuth, &c.

The Melting Vessel. The glass is melted in vessels made of difficultly fusible clay and chamotte-stone, which are heated on the hearth of the melting-oven. A glaze is first imparted to the vessels by melting broken glass and refuse in them. At the maximum temperature of the ovens, 1200°—1250° C., the glass has the consistency of a thin syrup, so that foreign substances can sink to the bottom of the vessel, and the clear molten glass can be run off. At a red heat glass can be welded by mere pressure.

Crown Glass. The materials used are: 100 parts of sand, 30 to 40 parts of soda, and 30 to 40 parts of calcium carbonate. The following analysis (by *Benrath*, 1869) shows the composition of this glass:

Silica	70·71	71·56	73·11
Soda	13·35	12·97	13·00
Lime	13·58	13·27	13·24
Alumina and oxide of iron	1·92	1·29	·83

This is the oldest kind of window glass, and is formed in the manufacture as discs of glass of about 6 inches in radius. Three workmen are employed in the manufacture of this glass; the first takes as much molten glass on the end of a pipe as will serve for a single disc, and passes pipe and glass to the second workman, the blower; he blows the glass into a large globe, which, when finished, he hands to a third workman, the finisher, who opens the globe and forms the sheet or pane.

Sheet Glass, or Cylinder Glass. This is made by blowing a cylinder of glass at the end of a pipe, opening out the ends, cutting it throughout its length, and beating or rolling it out flat on the table. This sheet glass is generally used for ground glass.

Plate Glass. This is either blown or cast; if

it is blown, the process is very similar to that used in the manufacture of sheet glass, but the chief method is by casting. Benrath found in English (a) and in German (β) plate glass—

	a.	β.
Silica	76·30	78·75
Soda	16·55	13·00
Lime	6·50	6·50
Alumina and oxide of iron	·65	1·75

As carried on at St Gobin and Ravenhead, the manufacture comprises: (1) the melting and clearing; (2) the casting and cooling; and (3) the polishing, which includes rough-polishing, fine-polishing, and finishing. The molten glass is poured on to a large flat metal table, and rolled to the thickness required; it is then cut into tablets, and polished.

Bottle Glass.—The materials for ordinary bottle glass are sand, potash or soda, basalt, &c. The analysis of several glasses gave the following results:

Silica	74·71	74·66	75·94
Potash	—	4·32	—
Soda	15·74	11·01	15·15
Lime	8·77	9·13	8·01
Alumina	·43		
Oxide of iron	·14	·88	·90
Oxide of manganese	·21		

To make an ordinary wine bottle, the workman takes some molten glass on his pipe, blows it into a pear-shaped globe, and then places it in a mould and blows sharply till the bottle takes the shape of the mould. The bottom of the bottle is then pressed in by means of a rod or 'puntil,' and the bottle is removed and placed in the annealing oven.

Water Glass.—By water glass is understood a soluble alkaline silicate. It is prepared by melting sand with much alkali. Potash water-glass is made by melting together 45 parts of quartz sand, 30 parts of potash, and 3 parts of wood charcoal. The mass obtained is dissolved in boiling water. Soda water-glass is prepared from quartz, 45 parts; soda, 23 parts; and charcoal, 3 parts. For technical purposes a mixture of 3 vols. of concentrated potash water-glass solution, and 2 vols. of concentrated soda water-glass solution is employed. Water glass is used to render wood, linen, and paper non-inflammable, and also as a cement. Chalk mixed with water glass forms a very compact mass, and dries as hard as marble. Another important application of water glass is in the painting of stone and concrete walls, and as a preservative to stonework, carving, &c., which are exposed to the weather.

The soda compound (silicate of sodium) is largely used as a dung-substitute in calico-printing, and by soap manufacturers in place of the resinates formerly in use; 10 or 12 tons are produced weekly in the district of South Lancashire. The potassa compound (silicate of potassium) has been recommended as a remedy for gouty concretions by Mr Ure.—*Dose,* 10 to 15 gr., in 6 or 8 fl. oz. of water twice a day. See DUNGING, VARNISH, &c.

Crystal Glass.—The materials used are 300 parts of sand, 100 parts of potash, 300 parts of cullet (broken glass), 200 parts of red-lead, and about ½ part of braunite and of arsenious acid. The melting process takes from 12 to 16 hours. Benrath (a) and Faraday (β) found by analysis—

	a.	β.
Silica	50·18	51·93
Oxide of lead	38·11	33·28
Potash	11·61	13·67
Alumina, &c.	·04	—

Crystal glass is either cast in brass moulds, or is ground; it is harder, and therefore takes a better polish than other glasses.

Optical Glass.—Both flint glass and crown glass are used for optical purposes; lenses of the two glasses may be combined so as to form an achromatic arrangement. Great care has to be bestowed upon the manufacture of optical glass in order to obtain it perfectly homogeneous.

Crown glass is not so liable to faults as flint glass. Crown glass may be made from sand, 120 parts; potash, 35; soda, 20; chalk, 15; and arsenious acid, 1 part. The materials used in the manufacture of flint glass are white sand, 100; minium, 106; and potash, 43 parts.

Tubes are made by rapidly drawing out a hollow cylinder, and from these a great variety of useful small apparatus may be constructed with the help of a foot-blowpipe.

GLASS BEADS are made from small tubes cut into pieces of suitable lengths, which are stirred first in a mixture of sand and wood-ashes, in the cold, and afterwards in an iron pan over the fire until they assume a rounded form. (See BEADS.) SMALL TUBES are bent in the flame of a spirit lamp or gas-jet, and cut by a file, a scratch being made, and the two portions pulled or broken asunder in a way easily learned by a few trials. LARGE TUBES require the heat of a powerful blowpipe and lamp, or that of a furnace.

Qualities of Glass. These are denoted by its hardness, transparency, homogeneity, strength, and power of resisting the action of water, air, light, and the stronger acids and alkalies. It should be noted that alkaline solutions dissolve quite an appreciable quantity of glass on long boiling; for this reason the precipitation of iron as ferric hydrate by ammonia should always be conducted in a *porcelain* vessel. The properties of glass depend very much upon the tempering which it receives; when allowed to cool extremely slowly it loses its transparency, and is then known as Réaumur's porcelain. If cooled quickly glass has a tendency to crack and fly to bits. Prince Rupert's drops consist of long pear-shaped drops of glass tapering to a very slender tail, and are formed by dropping molten glass into cold water. The bulb of one of these drops may be struck with a hammer, but if a small portion of the tail is snapped off the entire drop will break up with a loud report.

Analysis. A portion of the sample for analysis is heated to dull redness, and then suddenly thrown, whilst still hot, into a vessel of cold water. It is next dried, and reduced to fine powder in an agate or hardened steel mortar. About 1 grm. of the powdered glass is mixed with 4 times its weight of 'fusion mixture' (equal parts of sodium and potassium carbonates), and fused in a platinum crucible. When cold the crucible is placed in a porcelain basin, and the mass boiled out with water; hydrochloric acid is added in excess, the

whole evaporated to dryness over the water-bath, and then heated for some time in an air-bath at about 120° C., in order to render the silica insoluble.

Silica. The dried mass is then moistened with strong hydrochloric acid, hot water is added, and the silica is filtered off, washed several times with hot water, dried, and weighed.

Lead. Pass sulphuretted hydrogen through the filtrate to precipitate the lead; filter, dry the precipitate, and convert it into sulphate by treating it with nitric acid; ignite gently and weigh.

Manganese. Add a little bromine water to the filtrate from the lead sulphide, boil, filter off the manganese dioxide, convert it into the oxide Mn_3O_4 by ignition, and weigh.

Iron and Alumina. Add ammonia to the filtrate from the manganese, and weigh the iron and alumina together as oxides, Al_2O_3 and Fe_2O_3. Dissolve out the iron with hydrochloric acid, and estimate it volumetrically.

Lime. Add ammonium oxalate to the filtrate from the iron and alumina, filter off the precipitated calcium oxalate, convert it into carbonate by gentle ignition, and weigh.

Magnesia. Evaporate the filtrate to dryness, and ignite to expel ammonium chloride (or else boil down with nitric acid), then add strong ammonia and a solution of sodium phosphate. The magnesia is precipitated as magnesium-ammonium phosphate, $MgNH_4PO_4$; this is filtered off, washed with ammonia water, dried, ignited to convert it into $Mg_2P_2O_7$, and weighed.

Potassium and Sodium. A fresh quantity of powdered glass is taken, about 1·5 grm. mixed with 9 grms. of calcium carbonate and 1·5 grm. of ammonium chloride, and heated to redness for an hour in a platinum crucible by means of a Bunsen burner, a hollow clay cone being placed outside the crucible. When cold the contents of the crucible are boiled with water in a platinum dish and filtered; the filtrate is evaporated to dryness, and heated in an air-bath to render the silica insoluble. The residue is treated with hot water and filtered; to the filtrate ammonia, ammonium carbonate, and a little ammonium oxalate are added to precipitate the lime; the liquid is boiled and filtered. The ammonium chloride in the filtrate is expelled by boiling down with nitric acid; the nitric acid is then expelled by boiling with hydrochloric acid. The alkaline chlorides are dissolved in water, and the solution evaporated to dryness in a weighed platinum dish, which is then heated gently and weighed. The potassium chloride is precipitated as $PtCl_4.2KCl$ by the addition of platinic chloride. The weight of sodium chloride present is found by subtracting the weight of potassium chloride found from that of the mixed chlorides.

Concluding Remarks. To anticipate the results of his processes, and to carry out with certainty his various intentions, the glass manufacturer requires considerable scientific knowledge and great experience. All his most essential operations depend on chemical principles. The products of his furnaces are not formed by the mere mechanical admixture of their several ingredients whilst in the state of fusion, but result from the play of delicate affinities which only act under certain conditions, and when the materials are presented to each other in uniform and definite proportions. Chemically speaking, the glasses are mixed supersilicates of the respective bases which enter into their composition (potassium, calcium, lead, &c.), and obey the common laws of chemical combination. It has been shown by the most careful analysis that in all the more valuable and beautiful commercial glasses the relative proportions of the materials are conformable to these laws, and that several of them are true atomic compounds, as perfect in this respect as the crystalline bodies commonly denominated salts. In some of the harder glasses of Bohemia the number of molecules or equivalents of silica are to each of the bases with which it is united nearly as 5 to 1; whilst in a softer glass of German manufacture the proportions of the two are found to be as 4 to 1. The celebrated plate glass of St Gobain is an atomic compound formed of 1 equivalent of trisilicate of soda united to 1 equivalent of trisilicate of lime, with a small percentage of alumina in combination with silicic acid, also in atomic proportion. Glasses in which the ingredients bear no atomic ratio to each other are never homogeneous, but always more or less striated and of unequal colour and refractive power. The absence of atomic proportion between the substances entering into its composition appears to be the only reason why the best English plate and mirror glass is so greatly inferior to that of France and Germany. The only variety of glass in the production of which the English manufacturer excels is flint glass or crystal, and here he certainly surpasses all his numerous competitors. The subject is doubtless involved in difficulty, owing to the precise temperature necessary to effect the perfect combination of the bases with the silica varying with the character of the compound, and not being satisfactorily settled by observation or experience. The modifying influence of temperature is shown by the fact that the lower the heat employed in the process the smaller the quantity of silica which enters into the composition of the resulting glass, whilst at higher temperatures a part of the base is dissipated in fumes until such proportions of base and acid result as are required to produce a permanent atomic compound corresponding to the temperature employed. The common plan in this country is to regulate the proportions and firing by experience only, rather than by theory and practice combined. Now, although the chemist has much yet to learn on the precise constitution of the glasses, and although theory may not be able to ensure unvarying success, it is nevertheless certain that, in all cases, it can afford much valuable assistance in that direction. Indeed, it has been asserted by one of the leading Continental chemists that ingredients that will yield the proper equivalent proportions in the melting-pot cannot produce a bad glass if exposed to such a temperature as to permit of perfect combination taking place.

It is found that those glasses which contain a predominance of alkali are acted on by water, and when this is in great excess they are perfectly soluble in that fluid. Ordinary flint glass is affected by the prolonged action of hot water,

whilst crown glass, which contains less alkali, is nearly unaltered by this treatment. Glass which contains any considerable quantity of lead is acted on by sulphuretted hydrogen. This is the cause of the surface of flint glass, under certain circumstances, becoming opaque and iridescent. Glasses that have a slight greenish or bluish tint may be often whitened or rendered colourless by exposure to light and air. This arises from the peroxidation of the iron, to whose protoxide they owe their tint. Other glasses become purpled by exposure, owing to the peroxidation of the manganese.

Different colours are communicated to glass by the addition of metallic oxides. Thus, oxide of manganese gives an amethyst; oxide of cobalt, a blue; oxide of iron, a brown; black oxide of copper, a green; oxide of gold, a purple; suboxide of copper, a ruby-red; oxide of tin, a white; oxide of silver, a yellow, &c. These substances are either added to the melted contents of the glass-pot, as in preparing artificial gems, &c., or they are applied in a thin layer to the surface of the object, which is then heated until fusion of the coloured compound occurs, as in enamelling and painting on glass.

The following hints respecting the MANAGEMENT OF GLASS may prove useful to the inexperienced:

ANNEALING. The process of annealing glass has been briefly referred to before. The extreme brittleness of imperfectly annealed wrought glass may generally be remedied on the small scale by immersing the articles in a bath of oil, or a concentrated solution of chloride of calcium, or common salt, and heating the whole gradually and cautiously to the boiling-point, and letting it again cool—the slower the better. By this treatment the glass will be enabled to bear any alterations of temperature between the two extremes to which it has been exposed.

BLOWING. By the ingenious art of GLASS-BLOWING and GLASS-DRAWING, as practised on the small scale, with a foot blowpipe, a variety of articles of ornament and utility may be made, their number being limited only by the ingenuity of the artist. The details of the various operations are, however, too lengthy to describe here.

CLEANING. 1. Windows, looking-glasses, &c., may be quickly cleaned as follows:—Dip a slightly moistened rag or flannel into whiting, fuller's earth, wood-ashes, or rotten-stone, in impalpable powder, rub the rag over the glass and wipe it with a dry, soft cloth. This does well when the surface is very dirty. In other cases a little thumb blue, whiting, or chalk, in fine powder, tied up in muslin, may be dusted on the glass, and should then be cleaned off with chamois leather. This gives a fine polish.

Glass vessels may be cleaned by the action of strong sulphuric acid, especially if the acid is heated and some bichromate of potash added.

CUTTING. Glass may be easily cut by means of a common, well-hardened steel file, or, better still, by a 'glass-knife,' of very hard steel. Large tubes may be cut by making a scratch with a file or glass-knife, and then leading round the crack with a little knob of red-hot glass at the end of a tube or rod. The divided edges may be smoothed by the blowpipe flame, or by grinding them with powdered emery and water on a flat stone.

ETCHING ON GLASS. See ETCHING.

GRINDING. This, on the large scale, like glass-cutting, forms a distinct occupation. On the small scale, glass may be roughed or ground by friction with powdered emery and water and a flat rubber of wood; care being taken that the article, if a plate, is laid on a perfectly flat surface, or, if hollow, is supported by a core of cement or plaster. The frosted appearance of ground glass may be given to the panes of windows by gently dabbing the glass over with a piece of glazier's putty stuck on the ends of the fingers. When applied with a light and even touch the resemblance is considerable. Another method is to dab the glass over with thin white paint, or flour paste, by means of a brush, but the effect is not so good.

SILVERING. Plate glass is 'silvered' by means of an amalgam of tin and mercury. Tinfoil is beaten from pure tin; it is spread smoothly on a table, mercury is spread over it, and the glass plate (which must be perfectly clean) is pushed gently on to the surface, commencing at one edge. The glass is allowed to remain for 24 hours; it is then removed to a wooden incline and allowed to drain; the inclination is gradually increased till the plate is perpendicular, when the process is finished, and the mirror is removed to the store-room.

WRITING ON GLASS may be performed by a piece of French chalk or crayons prepared for the purpose; or even with a common pen held nearly perpendicular. Indian ink, or, when the article will be exposed to damp, shell-lac ink or varnish, thickened with a little vermilion or lamp-black, is best adapted to this purpose. Common ink is not sufficiently opaque.

Glass, Iridescent. The inventor of the process by which this beautiful variety of glass is made is M. Clémandot.

The 'Chemical News' states that the principle observed in its manufacture consists in submitting the glass articles to the action of dilute hydrochloric, sulphuric, or other acid, under a pressure of from 2 to 6 atmospheres. M. Clémandot claims to be able to imitate the nacreous films which are seen on ancient glass which has been exposed to combined atmospheric influences for thousands of years.

Glass, Packing. This subject will be considered under the general head of PACKING.

Glass, Pow'dered. *Syn.* VITRUM PULVERISATUM, L. *Prep.* Heat the glass red-hot, throw it into cold water, dry, and powder it. Used to filter acids, and, glued upon paper, for polishing metals, &c.

Glass (To prevent the cracking of, by boiling water). When new, all glass and earthenware should be placed in cold water in a saucepan, and after some hours the saucepan containing the vessel or vessels should be placed over the fire until the water reaches the boiling-point.

Glass, Toughened. *Syn.* VERRE TREMPÉ. M. de la Bastie's process for converting ordinary into toughened, tempered, or hardened glass, may in general terms be said to consist in heating the

glass to a certain temperature, and then plunging it into an oleaginous bath. For the process, however, to be successful, the observance of a number of minute details is essential; if these be neglected failure is certain to ensue. Thus it is found that if the glass be insufficiently heated it will, when immersed in the bath, fail to be affected by it, and will consequently experience no alteration in properties. Again, if over-heated, it will then get out of shape; or, further, it may be heated to the right temperature and yet be spoilt as it is being transferred to the bath. Moreover, the exact composition of the bath itself and its temperature constitute very important conditions, the most trifling departure from which may give rise to unsatisfactory results. All these obstacles appear to have been overcome by M. de la Bastie, who has designed plant in the shape of furnaces and bath, by means of which the tempering process can be carried out without chance of failure. When the glass is brought to the required temperature, all that is necessary is that it should be plunged into the bath, and instantly withdrawn. The cost of the operation is stated to be very small.

"The process as carried out at New York is thus described:—The glass, after being run from the furnaces and moulded as usual, instead of being put into annealing pans, is immersed in a hot bath consisting of 3 parts of flax-seed oil, and 1 part of tallow. The bath stands at about 320° F.; and after remaining in this the ware is removed to a second and similar bath, by which it is cooled down to about 200° F. Finally the pieces are immersed in a water-bath, and then dipped into a quantity of ordinary refined burning oil. They are then cleaned, ready for packing, with plaster of Paris powder. The work is but in its infancy, and but one small furnace is used in the experiments. Improvements will doubtless be made, by which the cleaning can be done more rapidly than by the powdered plaster, probably some chemical being used for the purpose. It is supposed that the oil works into the pores of the hot glass, and thus toughens it. Great care has to be exercised in the final cooling by water, as too long a contact with the air in changing from one bath to another makes the ware crack. Articles cooled entirely in oil retain the oil on the surface, but are thus rendered stronger than otherwise.

"This new process is very much employed in the manufacture of lamp chimneys, though they have the disadvantage of flying into small pieces and with violence when they do break, which sometimes does occur" (Supplement to 'Ure's Dictionary of Arts, Manufactures, &c.,' 1878).

The results so far obtained when glass is subjected to M. de la Bastie's process are variable. In some cases the articles subjected to it possess great toughness, and the glass bears a blow without experiencing any fracture. In other instances, however, a slight fall or blow shivers it to atoms. When the toughened glass under any circumstances breaks, it possesses a disadvantage over ordinary broken glass, in distributing itself into a great number of small, sharply angular fragments. The cause of this is perhaps to be sought for in some peculiar state of strain in which the molecules of the glass are placed by the toughening processes.

Another process for toughening glass, which has been patented by Herr F. Siemens, consists in heating, and then pressing, and suddenly cooling the glass to be hardened; but when the articles are such as are usually moulded, the hardening and tempering are accomplished at the same time as the pressing; thus the molten glass is run into suitable moulds, and, while still highly heated, is squeezed, the moulds effecting the necessary cooling, a proceeding which renders the employment of the oleaginous bath unnecessary. Mr Bauer's method for toughening glass consists in heating ordinary glass plates so strongly that they begin to bend from softening, and then plunging them into a liquid paraffin-bath having a temperature of 200° F.

Toughened glass is liable to rupture under circumstances that have not yet been accounted for.

M. de la Bastie conceives that the fragile nature of glass is due to the weakness of the cohesion of its particles, and that if this cohesive power can be increased, the strength of the material will be improved in proportion. M. de la Bastie first tried to obtain this end by forcibly compressing the glass while in a plastic or fluid condition, but without success; and it was only after various experiments that he was enabled to harden the glass, by dipping it into oil or any other liquid with a boiling-point higher than that of water.

GLAUBER'S SALT. *Syn.* Sodium sulphate. Formula $Na_2SO_4.10H_2O$. Found native as thenardite (NA_2SO_4), brogniartine or glauberite ($Na_2SO_4 + CaSO_4$), and it occurs in sea water and some mineral waters, as in those of Püllna and Carlsbad.

Prep. It is prepared by decomposing common salt with sulphuric acid, and indirectly in various processes, as (1) Lengmoid's process of roasting sulphide of iron or copper with common salt; (2) paraffin and petroleum refining; (3) the calcination of kieserite or magnesium sulphate with common salt.

Uses. This salt is extensively used in the manufacture of soda, ultramarine, and glass; it is also used in wool-dyeing, and in some metallurgical operations. Taken internally, it acts as a purgative.

GLAZE. *Syn.* Glazing. Any coating or varnish applied to the surface to render it smooth and glassy; any factitious, shining exterior. The applications of this term are the following:

Glaze, in *cookery*, is commonly understood to be gravy or clarified soup boiled until it gelatinises on cooling. It is used as a species of varnish to cover various dishes for the table, and may be spiced and flavoured according to the fancy of the cook. White of egg is generally used as a glaze for pastry.

Glaze. In the *porcelain* and *earthenware manufacture*, the vitreous coating which is so essential to the beauty and utility of potter's ware. Glazes are either white or coloured. The former, by the addition of the colouring ingredients used for enamels, are converted into the latter:

a. For EARTHENWARE:

Prep. 1. (With lead.) White-lead (pure), 53 parts; quartz or ground flints, 36 parts; Cornish stone, or felspar, 16 parts; white flint glass, 5 parts; reduce the whole to an impalpable powder. For common earthenware.

2. (Without lead.) Fine washed sand, 10 parts; purified potash, 8 parts; nitre, 1 part; slaked lime, 2 parts; nitre, $4\frac{4}{5}\%$; powder, mix, heat the mixture in a black-lead crucible in a reverberatory furnace, till the mass flows into a clear glass; let this cool, then reduce it to fine powder. For glazing pharmaceutical and chemical vessels.

b. For PORCELAIN:

Prep. (*Rose.*) Felspar, 27 parts; borax, 18 parts; finest siliceous sand, 4 parts; nitre, soda, and purest china clay (Cornish), 3 parts; mix, heat to a 'frit,' powder, and add of calcined borax, 3 parts. A technical term for the half-fused mass formed by heating together the materials of which glass is composed.

c. For STONEWARE:

1. (*Ure.*) White felspar, 26 parts; soda, 6 parts; nitre, 2 parts; borax, 1 part; 'frit' together as last. Of the product take 13 parts; red-lead, 50 parts; white-lead, 40 parts; flints, 12 parts; reduce the whole to powder as before. For painted stoneware.

2. From common salt, which is thrown into the heated furnace containing the ware. It is volatilised and decomposed by the joint agency of the silica of the ware and of the vapour of water always present; hydrochloric acid and soda are produced, the latter forming a silicate, which fuses over the surface of the ware, and gives a thin but excellent glaze. 'SALT-GLAZED STONEWARE' is now generally used for large chemical vessels, drain-pipes, &c.

Obs. Glazes must be reduced to very fine powder. For use they are ground with water to a very thin paste or smooth cream, into which the articles, previously baked to the state called 'biscuit,' are then dipped; they are afterwards exposed to a sufficient heat in the kiln to fuse the glaze. Another method of applying them is to immerse the biscuit in water for a minute or so, and then to sprinkle the dry powder over the moistened surface.

GLI'ADIN. *Syn.* GLUTIN, VEGETABLE GELATIN. One of the proximate principles of wheat-gluten, soluble in alcohol.

GLONOINE. Another name for nitro-glycerine, q. v.

GLOVE POWDER. *Prep.* 1. From Castile soap, dried by exposure to a warm dry atmosphere for a few days, and then reduced to fine powder in a mortar. Used to clean gloves.

2. Pipe-clay, coloured with yellow ochre, umber, or Irish slate, q. s., and afterwards scented with a little powdered orris-root or cloves. Used to colour gloves made of doeskin and similar leather.

GLOVES. *Syn.* GANTS, Fr. Although gloves constitute a less costly article of dress at the present day than they did during the Middle Ages, the following information may nevertheless be sometimes found of value to their wearers:

GLOVE-CLEANING. 1. (KID GLOVES.) *a.* Damp them slightly, stretch them gently over a wooden hand of appropriate size, and clean them with a sponge dipped in benzol, recently rectified oil of turpentine, or camphine; as soon as they are dry, withdraw them gently from the stretcher, and suspend them in a current of air for a few days, or until they cease to smell of the cleaning liquid used. The smell of benzol passes off very quickly. Heat must be avoided. The cleaning liquid should be used liberally, and the first dirty portion should be sponged off with clean liquid.

b. By employing a saponaceous compound. See GANTEINE.

2. (DOESKIN and WASH-LEATHER GLOVES.) *a.* Stretch them on a hand, or lay them flat on a table, and rub into them a mixture of finely powdered fuller's earth and alum; sweep it off with a brush, sprinkle them with a mixture of dry bran and whiting, and, lastly, dust them well off. This will not do if they are very dirty.

b. Wash them in lukewarm soft water, with a little Castile or curd soap, ox-gall, or bran-tea; then stretch them on wooden hands, or pull them into shape without wringing them; next rub them with pipe-clay and yellow ochre or umber, or a mixture of them in any required shade made into a paste with ale or beer; let them dry gradually, and, when about half dry, rub them well, so as to smooth them and put them into shape; when they are dry, brush out the superfluous colour, cover them with paper, and smooth them with a warm (not hot) iron.

GLOVE-DYEING. LEATHER GLOVES, if not greasy, may be dyed with any of the ordinary dyes by brushing the latter over the gloves stretched out smooth. The surface alone should be wetted, and a second or third coat may be given after the former one has become dry. When the last coat has become thoroughly dry, the superfluous colour should be well rubbed out, a smooth surface given them by rubbing them with a polished stick or piece of ivory, and the whole gone over with a sponge dipped in white of egg.

Gloves, Cosmetic. *Syn.* GANTS COSMETIQUES, Fr. These are mock kid or lambskin gloves rubbed over on the inside with the following composition:—Spermaceti cerate, 3 oz.; melt, add of balsam of Peru, $\frac{1}{2}$ dr., stir for 5 minutes, and, after a few minutes' repose, pour off the clear portion; to this add oil of nutmeg, 15 drops; oil of cassia and essence of ambergris, of each, 6 drops; and stir until cold. Used by ladies to soften the hands and to prevent or cure chilblains and chaps. They are commonly worn all night in bed.

GLUCOSIDES. Compounds of sugars with organic acids, occurring abundantly in plants. They split up into their components when heated with acids or alkalies, or through the action of ferments. Some of the most important glucosides are—Æsculin, in the bark of the horse-chestnut tree; amygdalin, in bitter almonds; tannins; indican, in wood, from which indigo blue is obtained; salicin, in willow-bark; and saponin, in soap-root.

GLUE. *Syn.* GLUTEN, GLUTINUM, L.; COLLE, COLLE FORTE, Fr. Inspissated animal jelly, or gelatin, used as a cement.

Prep. Glue is principally prepared from the parings and waste pieces of hides and skins, the

refuse of tanneries, and the tendons and other offal of slaughter-houses. These substances, when intended for the glue-maker, are steeped for 14 or 15 days in milk of lime, then drained, and dried by exposure to the air. This constitutes what is termed the 'cleansing' or 'preparation,' and in this state the 'glue-pieces,' as they are called, may be kept for a long time, and transported to any distance without suffering decomposition. Before conversion into glue they are usually again steeped in weak milk of lime, and next well washed and exposed to the air for 24 to 30 hours. They are then placed in a copper boiler 2-3rds filled with water, and furnished with a perforated false bottom, to prevent them from burning, and as much is piled on as will fill the vessel and rest on the top of it. Heat is next applied, and the whole gently boiled or simmered together, until the liquor on cooling forms a firm gelatinous mass. The clear portion is then run off into another vessel, and a very small quantity of alum (dissolved) added; here it is kept hot by a water-bath and allowed to repose for some hours to deposit its impurities, after which it is run into the 'congealing boxes,' and placed in a cool situation. The next morning the cold gelatinous masses are turned out upon boards wetted with water, and are cut horizontally into thin cakes with a stretched piece of brass wire, and then into smaller cakes with a moistened flat knife. The latter are placed on nettings to dry. The dry cakes of glue are next dipped one by one into hot water, and slightly rubbed with a brush wetted with boiling water, to give them a gloss; they are, lastly, stove-dried for sale. This furnishes the palest and best glue.

As soon as the liquor of the first boiling has drained off, the undissolved portion of skins, &c., left in the copper is treated with fresh water, and the whole operation is repeated again and again, as long as any gelatinous matter is extracted. In this way a second and other inferior qualities of glue are obtained. The product from dried glue-pieces is about 50%.

Var. These chiefly depend on the care with which the process is conducted. HATMAKERS' GLUE is prepared from the tendons of the legs of neat cattle and horses. It is brown, opaque, and soft; and grows moist in damp weather, but it does not render felt brittle like the other varieties. FISH GLUE is made in like manner from various membranous and solid parts of fishes. PARCHMENT GLUE is prepared from shreds or shavings of parchment, vellum, white leather, &c., dissolved by boiling them in water. It is scentless, and nearly colourless.

Qual. The best glue is transparent, nearly colourless, and tasteless, has very little smell, even when melted, and is extremely adhesive. The presence of more than a trace of alum is objectionable; an undue quantity may be easily detected by the usual tests. The strongest glue is that obtained from skins, more especially from the hides of oxen and cows. That obtained from bones, cartilages, and tendons is weaker.

Glue, Liq'uid. *Prep.* (*Dumoulins.*) Soft water, 1 quart; best pale glue, 2 lbs.; dissolve in a covered vessel by the heat of a water-bath, cool, and add, gradually, of nitric acid (sp. gr. 1·335), 7 oz.; when cold put it into bottles. Very strong, and does not gelatinise. For the 'LIQUID GLUE' sold in the shops, see CHINESE CEMENT.

Glue, Marine. *Prep.* 1. India rubber (cut small), 1 part; coal-tar or mineral naphtha, 12 parts; digest in a covered vessel with heat and agitation, and when the solution is complete, add of powdered shell-lac, 20 parts; continue the heat and stirring until perfect liquefaction has taken place, and pour the fused mass, whilst still hot, on slabs of polished metal or stone, so as to form thin sheets. For use, it is heated to its melting-point (248°—250° F.) in an iron vessel, and applied in the liquid state with a brush. Employed in ship-building, &c.

2. Caoutchouc, 15 to 20 gr.; chloroform, 2 fl. oz.; dissolve, and add of powdered mastic, ½ oz. It must be kept well corked and in a cool place, to prevent loss by evaporation. Used for small, fine work.

Glue, a New. Ordinary glue is dissolved in nitric ether, and a little bit of caoutchouc added. This solution forms a very strong glue, and does not get thick or pasty ('Dengler's Journal').

Glue, Port'able. *Syn.* BANK-NOTE GLUE, MOUTH G., INDIAN G.; COLLE À BOUCHE, Fr. *Prep.* From the best pale glue, 1 lb.; water, q. s.; dissolve in a double glue-pot or water-bath; add of pale brown sugar, ½ lb.; continue the heat until the mixture is complete, and pour it into moulds; or pour it on a marble slab, and when cold cut it into small pieces and dry them in the air. This glue is very useful to draughtsmen, architects, &c., as it dissolves almost immediately in warm water, fastens paper, &c., without the process of damping, and may be softened for many purposes with the tongue. When great strength is not required, 4 oz. more of sugar may be used.

GLU'TEN. *Syn.* GLUTIN. A peculiar substance found in the grain of wheat. It is composed of true vegetable fibrin and a small quantity of gliadin. It is prepared by washing paste made of the flour of wheat or rye in successive waters until all starchy matter is removed. The paste may be conveniently enclosed in a bag of fine linen during the washing.

Prop., Uses. Gluten is believed to be eminently nutritious. It is the presence of gluten in wheaten flour that imparts to it its viscidity or tenacity, and confers upon it its peculiar excellence for the manufacture of MACARONI, VERMICELLI, and similar pastes. The superiority of wheaten over other bread depends upon the greater tenacity of its dough, which during the fermentation is puffed up by the evolved carbonic acid, and retained in its vesicular texture so as to form a light loaf.

Gluten is greyish coloured, and extensible whilst fresh and moist, like caoutchouc. It turns blue when mixed with guaiacum-resin.

Gluten Bread. *Prep.* 1. From wheat-flour which has been deprived of about 2-3rds of its starch by washing it with water.

2. From gluten - flour. Recommended in diabetes.

Gluten Choc'olate. (*Gentile's.*) A mixture of cocoa and gluten-flour. As a nutritious and appropriate food in diabetes.

Gluten - flour. *Prep.* 1. From the waste

gluten of the starch-works washed, dried, and ground.

2. (*Gentile's.*) From the last, mixed with about an equal weight of wheat-flour.

The manufacture of bread and biscuits containing a minimum of starch is now become a recognised business, and has been carried to considerable perfection by Messrs. Van Abbott, who prepare biscuits and cakes from various nut-flours, *e. g.* almond, Brazil, walnut, cocoa-nut, Turkish nut, &c., for the use of diabetics; also bran biscuits from bran powder which has been well washed to remove the starch. These are useful to correct the constipation produced by the habitual use of gluten bread.

GLYC'ERIN. $C_3H_8O_3$. *Syn.* GLYCERINE; GLYCERINUM, L. A sweet syrupy liquid formed during the saponification of oils and fats.

Prep. 1. Olive oil (or other suitable oil), protoxide of lead, and water are heated together until an insoluble soap of lead (lead plaster) is formed. The glycerin remains in the aqueous liquid. As this crude solution of glycerin is produced in great quantities in the manufacture of lead plaster, the operative chemist has only to purify it. This may be done as follows:

The water and washings from lead plaster are mixed together, filtered, and submitted to the action of a stream of sulphuretted hydrogen, to throw down the lead; the supernatant liquor is decanted from the precipitate, filtered, and evaporated in a water-bath to the consistency of a syrup. To render it quite pure it is diluted with water, decolourised with a little animal charcoal, filtered, and again evaporated to the consistency of a thin syrup, after which it is further evaporated *in vacuo*, or over sulphuric acid, until it acquires the sp. gr. 1·265.

2. (*M. Bruère-Perrin.*) From the sweet liquor of the stearin works (a product of the process of lime saponification). The quantity of lime present in the sample is first determined by means of oxalic acid, and the proportion of sulphuric acid necessary for its saturation at once calculated and added; the crude liquor is then concentrated in a tinned-copper vessel, evaporation being promoted by brisk agitation until the sp. gr. sinks to 10° Baumé; it is next cooled and filtered, and accurately neutralised (if necessary) with carbonate of potash, after which it is evaporated to the sp. gr. 24° Baumé; on cooling, it deposits gelatinous sulphate of potash; the whole is then filtered, the deposit on the filter washed with a little very weak spirit and water, the filtrate and washings mixed together and evaporated, as before, with agitation, until the sp. gr. 28° Baumé, whilst hot (36° cold), is attained, the whole is then allowed to cool; the clear liquid is, lastly, decanted and filtered. In this state it has an amber colour, but may be rendered colourless and odourless by rediluting it with water, treating it with animal charcoal, filtering, and again evaporating to a proper consistency.

The lime may also be precipitated by a stream of carbonic acid gas, or by a solution of carbonate of soda; the liquor is then boiled, filtered, evaporated to a syrupy consistency, and again filtered.

3. By saponifying olive oil with caustic alkali, decomposing the resulting soap with dilute sulphuric or tartaric acid, evaporating the aqueous portion to dryness (nearly), dissolving out the glycerin with cold rectified spirit, and filtering and evaporating the solution as before.

4. (*Reynolds'* Patent.) The soap-boiler's mother-liquor is first concentrated by evaporation, the saline matter which separates out being removed from time to time. When the fluid is sufficiently concentrated (which is the case when the boiling-point has risen to 116° F.), it is transferred to a still, and the glycerin distilled off by means of superheated steam carried into the still. The distillate is then concentrated and brought to the consistency of a syrup in a vacuum pan.

5. (*Price's* Glycerin. Patent dated 1854.) Superheated steam of from 550°—600° F. is introduced into a distillatory apparatus containing palm oil or some other fatty body. The action of the steam effects the decomposition of the fat, and glycerin and the fatty acids distil over together, but no longer in combination. In the receiver the condensed glycerin, from its higher specific gravity, sinks below the fatty acids. Sufficient steam must be supplied, and the temperature nicely regulated. The glycerin is concentrated by evaporation, and if discoloured, it is redistilled. It is usually prepared with sp. gr. 1·24, and then contains 94% of anhydrous glycerin. It can, however, be concentrated to sp. gr. 1·26, when it contains 98%.

Prop. Pure glycerin is a colourless, odourless, uncrystallisable liquid, sweet to the taste, and of a syrupy consistence; it mixes with water in all proportions; it is unctuous and emollient, and softens bodies, like oil, but without greasing them; it does not evaporate or change in the air at ordinary temperatures; mixed with yeast and kept in a warm place, it is gradually converted into propionic acid; a strong heat decomposes it, with the production of acrolein; it is neutral to test-paper, and possesses neither basic nor acid properties; it is easily charged with the aroma of the essential oils, and may be combined with soap, and many other substances, without undergoing change. Sp. gr. 1·265.

MM. Champion and Pellet recommend the following methods for testing the purity of glycerin, as being convenient in application, and giving accurate results.

Qualitative Test. The glycerin diluted with twice its weight of water is treated in the cold.

(1) With basic acetate of lead. If an abundant precipitate be formed and rapidly deposited, the presence of a proportion of foreign matters may be assumed which would make it unsuitable for use in various applications, such as the manufacture of nitro-glycerin, &c. The crude glycerin obtained in treating fats with sulphuric acid is frequently thus contaminated. These foreign matters result from the action of sulphuric acid at a high temperature (about 110° C.) upon the fatty matter itself or on the impurities it may contain.

(2) Glycerin obtained by calcareous saponification also may contain oleate of lime. This may be detected with oxalate of ammonia, which throws down the lime as a clearly perceptible precipitate.

The colour of glycerin is in no way an index

of the purity of the product. In all cases it is useful to be assured of the neutrality of the glycerin.

The preceding tests are suited for glycerins more or less impure, but not adulterated. Any addition of glucose may be detected by Fehling's solution.

Quantitative Test. This test should comprehend the determination of the water, the foreign organic matter, the lime, the sulphates and chlorides (if any), and the glycerin.

Estimation of Organic Matter. 50 grms. of glycerin diluted with water are treated with an excess of basic acetate of lead, the precipitate collected on two tared filters, and the lead compound weighed. The whole is then calcined, the residue treated with nitric acid, and then with sulphuric acid, and from the weight of the sulphate of lead is calculated the quantity of oxide of lead that was in combination with organic matter, and consequently the proportion of the latter; it rarely exceeds 1% to 1·5%.

The proportion of mineral matter may be determined by igniting about 5 grms. of the glycerin in a platinum crucible until any carbonaceous residue disappears; the mineral impurities remain and may be weighed. Treated in this manner a distilled glycerin never yields more than ·2% of ash, but in raw glycerin from soap leys the ash ranges from 7% to 14%.

Calcium, which occurs chiefly as calcium oleate, is most readily determined by precipitation from the diluted glycerin by means of ammonium oxalate.

Chlorides are best determined in the ash left after ignition of a sample of glycerin. The ash is exhausted with water, and the chlorides estimated volumetrically by means of a standard silver solution.

Sulphates may be determined by precipitation from the diluted glycerin by barium chloride.

There is no quick and accurate method of estimating glycerin itself known at present, but it may be determined, in the absence of foreign bodies yielding oxalic acid on oxidation, by means of a standard permanganate solution in presence of excess of caustic alkali. The glycerin is converted into oxalic acid, carbon dioxide, and water; the excess of permanganate is destroyed by a sulphite, and the oxalate determined as a calcium salt.

If the glycerin is mixed with water only, the proportions may be determined by taking the sp. gr. of the mixture, either by hydrometer or by hydrostatic balance, preferably the latter.

The following table, by Skalweit, gives the sp. gr. at 15° of mixtures of glycerin and water in various proportions:

Percentage of Glycerin.	Sp. gr.	Percentage of Glycerin.	Sp. gr.
0	1·000	55	1·143
5	1·012	60	1·157
10	1·024	65	1·171
15	1·036	70	1·185
20	1·049	75	1·199
25	1·062	80	1·212
30	1·075	85	1·226
35	1·088	90	1·239
40	1·102	95	1·252
45	1·115	100	1·265
50	1·129		

The following qualitative test, which it is said will detect, upon concentration of the fluids, $\frac{1}{10}$% of glycerin in beer, 1% in sherry, 1% in milk, and 5% in treacle, is based upon a fact observed by Iles, viz. that borax when treated with glycerin gives to a Bunsen flame the green colour characteristic of boracic acid. The method of its application as given by Messrs Senier and Lowe is as follows:—The suspected solution is rendered alkaline by dilute soda, and a borax bead placed in it for a short time. The bead is then held in a Bunsen flame, when, if the solution contains 1% of glycerin, a distinct reaction is observed. Erythrite and glycol give the same colour.

If a small quantity of glycerin from which the fatty acids have not been removed be poured into the palm, and rubbed between the hands, a peculiar fœtid, mouse-like odour will be perceived.

Uses, &c. Glycerin is extensively employed as an excipient for medicines, also, either alone or in lotions, baths, &c., as a soothing emollient, and is added to poultices and dressings instead of oil, to prevent their hardening. Diluted with water it often succeeds in allaying itching and irritation of the skin when all other means fail. As a cosmetic, either made into a lotion or added to soap (glycerin soap), or used in small quantities along with the water employed in washing, it imparts a healthy clearness and a sensation of softness and coolness to the skin, which is very agreeable and refreshing. It is the best remedy known for chapped nipples, hands, lips, &c.; all of which may be prevented by its use as an article of the toilet. Glycerin is sometimes used as a sweetening agent, as a substitute for syrup.

Glycerin is employed for a great variety of purposes other than medicinal; such, for example, as for keeping clay moist for the modeller, for preventing mustard from drying up, for keeping snuff damp, for the preservation of fruit, for sweetening liqueurs, wine, beer, and malt extracts. It is also used as a lubricant for some kinds of machinery, more especially for watch and chronometer works, because it is unaffected by contact with the air, does not thicken at a low temperature, and is without action on such metals as copper, brass, &c. Glycerin is also an ingredient in copying inks. It renders printing ink soluble in water; indeed, it is an excellent solvent for many substances, including the tar-colours (aniline blue, cyanine, aniline violet, and alizarin) and arsenious acid. It is also added to the pulp of paper in order to render it soft and pliable. It is said that leather driving-belts made as they usually are of weakly tanned leather, when kept in glycerin for twenty-four hours are not so liable to fray. A solution of glycerin in water is now largely used instead of water alone for the purpose of filling gas-meters, as such a solution does not freeze in winter nor evaporate in summer. It has also been used for the compasses on board screw-steamers, in order to protect the inner compass-box against the vibrations caused by the motion of the propeller. It is also employed for the preservation of anatomical preparations, for mounting microscopic specimens, for rendering wooden casks impervious to petroleum or other oils, and for the preparation of artificial oil of mustard, or allyl-sulphocyanide,

which is made by treating glycerin with iodide of phosphorus, dissolving the allyl-iodide formed in alcohol, and distilling the solution with potassium sulphocyanide. When treated with concentrated nitric acid, glycerin yields nitro-glycerin (Wagner's 'Chemical Technology').

Even the above long list does not exhaust the many useful purposes to which glycerin is now applied.

For further particulars, *see* Allen's 'Commercial Organic Analysis.'

Glycerin Cream. Oil of sweet almonds, 8 fl. oz.; spermaceti, 3 oz.; white wax, 1 oz.; borax, ½ oz.; glycerin, 3 fl. oz.; orange-flower water, 1 oz.; oil of neroli, 5 drops; oil of rose, 3 drops. Melt the wax, spermaceti, and oil of sweet almonds together; dissolve the borax in the orange-flower water and glycerin previously mixed; pour the solution, a little at a time, into the melted mixture, stirring the preparation without ceasing, until all the solution has been fully incorporated and a homogeneous product results; finally add the oils.

Glycerin Cream with Camphor. Glycerin, 2 parts; camphor, 1 part; rectified spirit, 1 part; mix. For chilblains.

Glycerin Cream for Chilblains. Equal parts of glycerin, soft soap, and cherry-laurel water, mixed together.

Glycerin Jelly for Chapped Hands. *Prep.* 1. Gelatin, 2½ parts; glucose, 10 parts; glycerin, 60 parts; water, 27½ parts. Mix the glycerin and water, and then dissolve in the mixture, first the glucose and then the gelatin, with the use of a gentle heat; perfume with otto of rose, and place in bottles while still warm.

2. Tragacanth, 1 part; glycerin, 15 parts; water, 34 parts. Perfumed with oil of rose geranium.

Glycerin Jelly for Microscopic Mounting. ('Ed. Pharm. Journal.') Soak any quantity of good clean gelatin in cold water for three or four hours. Pour off the superfluous water and melt the gelatin at a gentle heat; when melted filter through flannel, and to the filtrate add an equal quantity of Price's glycerin.

The above forms a good firm jelly, requiring little trouble in securing the cover.

Glycerin Ointment. Glycerin, 8 parts; spermaceti, 4 parts; white wax, 1 part; oil of almonds (fixed), 16 parts. Add the glycerin to the melted ingredients, and stir briskly till cold. For chaps and excoriations.

GLYCERINS. *Syn.* Glycerites, Glyceroles. Mixtures or solutions of various substances in glycerin. Glycerin being a valuable solvent and preservative, it yields permanent preparations which are conveniently kept ready made. They afford an easy method of making solutions of substances with water or alcohol, as in most cases they admit of dilution without separation.

Glycerin of Alum. (B. P.) Alum, 1 part; glycerin, 5 parts. Dissolve with heat.

Glycerin of Belladonna. (P. Cod.) Extract of belladonna, 1 part; glycerin of starch, 10 parts. Mix well.

Glycerin of Belladonna. (Univ. Hosp.) Extract of belladonna, 1 part; water, 1 part; glycerin, 1 part. Mix well.

Glycerin of Bismuth Nitrate. Nitrate of bismuth (cryst.), 1 part; glycerin, 8 parts.

Glycerin of Borax. (B. P.) Borax, 1 part; glycerin, 4 parts; water, 2 parts.

Glycerin of Carbolic Acid. (B. P.) Carbolic acid, 1 part; glycerin, 4 parts.

Glycerin of Carmine. Carmine, 60 gr.; distilled water, 1 dr.; solution of ammonia, 80 minims; dissolve and add gradually 6 dr. of glycerin. Heat in a water-bath till free from ammonia; when cold add 20 minims of solution of ammonia, so as to prevent it gelatinising. Used for staining organic tissues in microscopic work.

Glycerin of Gallic Acid. (B. P.) Gallic acid, 1 part; glycerin, 4 parts.

Glycerin of Gelatin. Gelatin, 1 part; immerse in 4 parts water for a few seconds; drain off the water; add 4 parts glycerin; then dissolve by heat. Used as a base for gelatin suppositories and pessaries.

Glycerin of Iodine. Iodine, 20 gr.; glycerin, 1 oz.

Glycerin of Lead Subacetate. (B. P.) Acetate of lead, 5 parts; oxide of lead, 3½ parts; glycerin, 20 parts; water, 12 parts. Mix, boil 15 minutes, filter, and evaporate off the water.

Glycerin of Pepsin. Scrape the inner coat of the stomach of the pig; to each ounce of the scrapings add 1 oz. dilute hydrochloric acid, 2 oz. water, and 6 oz. of glycerin; then filter.—*Dose*, ½ to 2 dr.

Glycerin of Starch. (B. P.) Starch, 1 part; glycerin, 5 parts; water, 3 parts. Mix and dissolve with heat.

Glycerin of Tannic Acid. (B. P.) Tannic acid, 1 part; glycerin, 4 parts.

Glycerin of Tar. (P. Cod.) Purified tar, 1 part; glycerin of starch, 3 parts.

Glycerin of Tragacanth. (B. P.) Powdered tragacanth, 3 parts; glycerin, 12 parts; water, 2 parts; mix till it forms a jelly.

Glycerin of Yelk of Egg. (Ph. U. S.) Fresh yelk of egg, 45 parts; glycerin, 55 parts. Rub them together gradually.

GLYCOCINE. *Syn.* Glycoll, Sugar of gelatin. $C_2H_5NO_2$. This is one of the products of the decomposition of gelatin when boiled with dilute sulphuric acid; after the acid is removed by means of barium carbonate, the glycocine may be procured in crystals by evaporating the solution.

It may also be obtained by heating gelatin with a solution of potash or of soda. It is, however, most easily separated in a state of purity by boiling hippuric acid for ½ an hour with hydrochloric acid; as the liquid cools benzoic acid is separated in abundance, and glycocine remains in combination with hydrochloric acid. On the addition of absolute alcohol, after the solution has been concentrated by evaporation and supersaturated with ammonia, pure glycocine is deposited in minute crystals.

Pure glycocine has a sweet taste, inferior to that of cane-sugar. It is soluble in about 400 parts of cold water, less soluble in rectified spirit, and insoluble in absolute alcohol and in ether. It is not susceptible of the alcoholic fermentation.

GLYCO-GELATIN. (Throat Hosp.) Refined gelatin, 2 parts; glycerin, 5 parts; orange-flower water, 5 parts; ammoniacal solution of carmine, a sufficiency to colour red. Soak the gelatin in the water, add the glycerin, and dissolve with heat. When nearly cold add the carmine. This forms a useful basis for pastils, and can be medicated as desired. Pastils are useful in disorders of the tongue, throat, and chest.

GLYCYR'RHIZIN. *Syn.* LIQUORICE SUGAR. An uncrystallisable variety of sugar obtained from the root of common liquorice (*Glycyrrhiza globra*). It is yellow, transparent, soluble in both water and alcohol, and is not susceptible of the vinous fermentation.

GLYSTER. See ENEMA.

GNATS and MOSQUI'TOES. See BITES and STINGS.

GNEISS. A rock consisting of intermixed crystals of quartz, felspar, and mica. Its composition is nearly the same as that of granite, but it has a more stratified appearance, as the mica occurs more in layers.

GOA POWDER. See ARAROBA.

GOITRE. *Syn.* DERBYSHIRE NECK, BRONCHOCELE, TRACHEOCELE; HERNIA BRONCHIALIS, L. A tumour on the fore-part of the neck. It sometimes occurs in Derbyshire, and is endemic in the Alps and several other mountainous districts. Iodine and the iodides appear to be the only substances capable of curing or even arresting the progress of this disease.

The cause of the disease is as yet uncertain, but hard drinking-water and snow-water seem to be associated with goitre.

The disease called cretinism, which is a peculiar form of idiocy, is in some countries more particularly frequently associated with goitre. Both these maladies prevail in Wurtemberg, Saxony, Silesia, the Tyrol, Carinthia, Galicia, Austria, and Switzerland. In England, goitre seems principally confined to the magnesian limestone district extending from Nottingham to the Tyne; it also prevails in a smaller degree in Derbyshire, Norfolk, Cambridge, and Somersetshire, where a few scattered cases of cretinism are to be met with. Goitre is very much more general than is usually supposed in France. In Asia it is to be found amongst the inhabitants of Chinese Tartary, Thibet, and Ceylon, and in India amongst the dwellers in the valleys and extensive plains that lie at the foot of the Himalayan mountains.

The disease is likewise known to exist in many parts of Africa; goitre is also far from uncommon in certain districts of North America; whilst in South America it is met with amongst the people inhabiting the plateaus of New Granada, which comprise localities differing greatly in climatic conditions, as deep and humid valleys, and arid plains almost or entirely destitute of verdure.

GOLD. Au. *Syn.* AURUM; OR, Fr.; GOLD, Ger. Gold is the most valuable and, probably, the longest known of all the metals. From the remotest period it has been esteemed for its beauty and permanence, and has been taken as the standard measure of value amongst all civilised nations. An account of the uses of gold in the *arts*, and its influence on society in all ages, as a symbol of wealth and an article of ornament and utility, would embrace the whole history of mankind.

Gold is found almost invariably in the metallic state. It occurs as gold dust in the sands of various rivers, and in the alluvial soil of auriferous districts, from both of which it is obtained by the simple process of washing. Traces of it are constantly found in the iron and other pyrites of the more ancient rocks. Sometimes it occurs beautifully crystallised in the cubic form, associated with quartz, oxide of iron, and other substances, in regular veins. In the gold-fields of California and Australia lumps of nearly pure gold have been discovered in abundance. In the former country a mass of gold weighing 28 lbs. was found, whilst in our own colonies one weighing 106 lbs. was dug out of a quartz rock near Bathurst. The latter contained upwards of 91% of pure gold, and nearly $8\frac{1}{2}\%$ of silver; being as pure as the English sovereign, or, in trade language, '22 carats fine.'

The chief gold-yielding countries are: Africa, Hungary, the Ural, Australia, and America, especially Mexico, Peru, the Brazils, California, Columbia, and Victoria.

Mode of Extracting Gold. By far the largest portion of the gold in circulation is obtained by the washing process; this may be carried on in remote districts in a very primitive manner, by simply putting the sand into wooden bowls and washing it gradually with water. Wherever gold-washing is a regularly established business, properly constructed contrivances are applied.

Extraction by means of Mercury. This method depends upon the fact that mercury very readily forms an amalgam with gold. The process is carried on in peculiarly constructed mills, or by washing the crushed quartz or sand over a sluice of sheet copper, with little projections of copper amalgamated with mercury; the gold amalgamates and collects against the copper ledges. The excess of mercury is removed from the amalgam by pressure in leathern or stout linen bags; the remainder in amalgamation with the gold is volatilised by ignition in suitably constructed furnaces.

Smelting for Gold. By this method a crude iron is produced, from which the gold is separated by means of sulphuric acid. This process yields from 25 to 30 times as much gold as the washing process.

Extraction of Gold from Poor Minerals. Chlorine water, or an acidulated solution of bleaching powder, is sometimes used for this purpose; the gold is converted into chloride of gold, and is precipitated from the solution by sulphate of iron, or by sulphuretted hydrogen.

Refining. This may be accomplished in several ways: (1) by means of antimony sulphide, Sb_2S_3; (2) by means of sulphur and litharge; (3) by cementation; (4) by quartation; (5) by means of sulphuric acid. The last-named method is the only important one; almost any alloy containing gold in addition to copper and silver can be treated, but the quantity of gold should not exceed 20%, nor that of the copper 10%. The alloy intended for this operation is first granulated, and then heated for about 12 hours, together with concentrated sulphuric acid, in cast-

iron or porcelain vessels. The copper and silver dissolve, and sulphurous acid is evolved and employed in the manufacture of sulphuric acid, or is absorbed by a soda or lime solution to form sulphite or bisulphite of soda or bisulphite of lime. The solution of mixed sulphates of silver and copper is poured into leaden pans; it solidifies on cooling, and the pasty mass is dug out with iron spades and put into leaden tanks filled with boiling water. The silver is precipitated from the solution by strips of copper, and the copper in solution is recovered in the form of blue vitriol. The gold remains undissolved in the form of a dark, insoluble, spongy mass; it is first boiled with a solution of carbonate of soda, and next with nitric acid; it is then dried and melted with the addition of saltpetre. By this process the $\frac{1}{10}\%$ to $\frac{1}{12}\%$ of gold contained in old silver coins has mostly been recovered, and the silver often contained in gold ingots is extracted by a similar method.

The silver may also be separated in the following way, patented in 1851 by Mr W. E. Newton:—The argentiferous substance, whether in the state of ore or bullion, is reduced to a granulated or spongy state by fusion along with zinc, or some other metal cheaper than silver, and the zinc is subsequently removed by digesting the resulting granulated, laminated, or pulverulent alloy in dilute sulphuric acid, or other acid. The zinc, &c., is recovered by the usual means. This process, carefully conducted, produces metal of great ductility and purity, containing 99% to 99½% of pure gold.

Chemically pure gold is obtained by dissolving the metal in nitro-hydrochloric acid, adding a solution of protosulphate of iron, and collecting and washing the precipitate. In this state it is a brown powder, which acquires a metallic lustre by friction or heat.

Prop. The most marked properties of gold are its rich yellow colour, its ductility, malleability, insolubility in all menstrua except 'aqua regia' (nitro-hydrochloric acid), aqueous chlorine, and hydrofluoric acid, and its very slight affinity for oxygen. It melts at a bright red heat (2316° F., *Daniell*), and the fused metal has a brilliant green colour. It forms compounds with chlorine, iodine, oxygen, sulphur, &c. Sp. gr. of native gold, 13·3 to 17·7; of pure gold, 19·3 (average); its greatest density is 12·5. Solutions of gold exhibit the following reactions: Ferrous sulphate gives a brown precipitate, which acquires a metallic lustre when rubbed; stannous chloride (preferably containing a little perchloride) gives a violet, purple, or blackish precipitate, insoluble in hydrochloric acid; sulphuretted hydrogen and hydrosulphide of ammonia give a black precipitate, insoluble in simple acids; ammonia gives a reddish-yellow precipitate ('fulminating gold') with tolerably concentrated solutions, either at once or on boiling the liquid; caustic potash gives a reddish-yellow precipitate with neutral solutions of gold, insoluble in excess. Borax beads, when fused with a small quantity of a gold compound, become rosy by reflected light, and blue by transmitted light.

Extraction of Gold by Sodium Amalgam. (*Crookes's* Method—patented.) In the extraction of gold by amalgamation the mercury is apt to become very finely divided, and the gold tarnished, so that the process is very incomplete. Mr Crookes discovered that the addition of a small quantity of sodium to the mercury prevents these difficulties (called 'flouring' and 'sickening'), and his process has been generally adopted. It increases the yield of gold by from 5% to 30%.

Estim. 1. In the dry way:

The quantity of gold in an ALLOY is usually estimated by 'assaying' the sample. Before proceeding to the assay, it is necessary to form some estimate of the quantity of other metals (copper or silver, or both) in the specimen to be examined, in order to employ the proper proportion of lead in the 'cupellation.' The experienced assayer commonly does this by the 'assay of the touch,' and, in certain cases, by a rough preliminary assay. The quantity of lead employed may be about 16 times the weight of the copper present in the sample, and when the alloy contains silver an additional allowance of lead, equal to 1-10th of its weight, is made on that account. When no silver is present, or it is not required to be estimated, a much larger proportion of lead may be employed. The weight taken for the assay ('assay pound') is usually 12 or 6 gr. The alloy and dose of lead being accurately weighed and separately wrapped in small pieces of paper, the assay may be at once proceeded with.

α. CUPELLATION. This operation, the most important of the whole, has been already described. Unlike silver, gold will bear the highest heat of the furnace without 'vegetating,' 'fuming,' or being absorbed by the cupel. The loss of weight gives the amount of copper in the alloy.

β. QUARTATION. The cupelled sample is fused with three times its weight of pure silver (called the 'witness'), by which the gold is reduced to 1-4th of the mass, or less, and in this state may be easily removed.

γ. PARTING. The alloy, after quartation, is hammered or rolled out into a thin strip or leaf, curled into a spiral form, and boiled for a quarter of an hour, in a small flask, with about 2½ to 3 oz. of nitric acid (sp. gr. 1·3); and the fluid being poured off, it is again boiled in a similar manner with 1½ to 2 oz. more of nitric acid (sp. gr. 1·2), after which the gold is carefully collected, washed in pure water, and dried. When the operation of 'parting' is skilfully conducted, and the acid not too strong, the metal preserves its spiral form; otherwise it falls into the state of flakes or powder. The second boiling or digestion is technically termed the 'reprise.' The loss of weight by 'parting,' after deducting that of the 'witness,' corresponds to the quantity of silver originally in the specimen.

δ. ANNEALING. This consists in putting the pure gold obtained by the last process into a small porous crucible or cupel, and heating it to redness in the muffle.

ε. WEIGHING. This must be done with the utmost accuracy. The weight in grains troy, doubled or quadrupled, as the case may be, gives the number of carats fine of the alloy examined, without calculation.

2. In the wet way:

The richness in gold of any substance, whether liquid or solid, when the quantity is small (and indeed in all other cases), is most simply and economically determined by the common method of chemical analysis. The gold may be thrown down from its solution by adding a solution of protosulphate of iron; the precipitate, after being washed, dried, and gently heated, may be weighed as pure gold.

The gold may also be precipitated as sulphide by sulphuretted hydrogen, or as oxalate by oxalic acid, and converted into metallic gold by ignition.

Pois., &c. The soluble preparations of gold (chlorides) are violent poisons. The symptoms resemble those occasioned by corrosive sublimate, but are somewhat less violent. Metallic gold in a minute state of division is also capable of producing very unpleasant consequences, and even endangering life. The antidote is iron filings or a solution of sulphate of iron, given conjointly with an emetic.

Uses. The most extensive is its application to coinage, and next that to gilding and jewellery. Gold in sheets $\frac{1}{8}$ in. thick has been used to cover the large dome of Isaac's Church at St Petersburg, while three at least of the crosses on the domes of the Moscow churches are made of solid gold. Pure gold is only used for certain chemical purposes, and for the manufacture of gold-leaf; the Staffordshire potteries consume £60,000 annually for this purpose alone. All other gold is alloyed with copper or silver to produce the degree of hardness necessary for hammering, stamping, &c. The proportion of gold in an alloy is expressed by saying it is so many 'carats' fine, pure gold being called 24-carat gold; standard gold as used for coinage is 22 carats fine, containing 22 parts of pure gold to 2 parts of copper.

In *medicine,* gold has been given in the form of powder, in scrofula and syphilis, by Chrestein, Niel, and others, with apparent advantage.—*Dose,* $\frac{1}{4}$ gr. to 1 gr., 3 or 4 times a day, in pills or as a friction on the tongue and gums. An ointment made of 1 gr. of powdered gold and 30 gr. of lard has been applied by Niel to the skin deprived of the epidermis (endermically) in the above diseases.

The more important chemical compounds containing gold, the alloys, and commercial forms of the metal, together with certain factitious substances popularly called 'gold,' are noticed in alphabetical order *below.*

Gold, Alloys and Preparations of:

Gold, Artificial. *Prep.* From copper, 16 parts; platinum, 7 parts; zinc, 1 part; fused together. This alloy resembles in colour gold of 16 carats fine, or 2-3rds, and will resist the action of nitric acid, unless very concentrated and boiling.

Gold, Dutch. *Syn.* MANNHEIM GOLD, MOSAIC G., ORMOLU, PINCHBECK, PRINCE'S METAL, RED BRASS, SIMILOR, TOMBAC. These names are applied to several varieties of fine gold-coloured brass, differing slightly in tint and in the proportions of copper and zinc.

At the celebrated works of Hegermühl, near Potsdam, the proportions of copper, 11 parts, to zinc, 2 parts, are employed to produce a metal which is afterwards rolled into sheets for the purpose of making Dutch leaf-gold. This alloy has a very rich, deep gold colour. Its malleability is so remarkable that it may be beaten out into leaves not exceeding $\frac{1}{52000}$ in. in thickness.

Gold, Grain. *Syn.* AURUM GRANULATUM, L. *Prep.* From cupelled gold, 1 part; silver, 3 parts; melted together and poured in a small stream into water; the silver being afterwards dissolved out by digestion in boiling nitric acid, and the grains, after being well washed in water, heated to redness in a crucible or cupel. Used to make preparations of gold.

Gold, Jew'eller's. This term is applied to alloys of gold used for trinkets and inferior articles of jewellery, ranging from 3 or 4 carats fine upwards; or which are too inferior to receive the 'Hall mark.'

Gold, Leaf-. *Syn.* GOLD-LEAF. Gold reduced to leaves by hammering it between thin animal membrane. Its preparation constitutes the trade of the goldbeater. These leaves are only $\frac{1}{282000}$ in. in thickness. Gilt silver is hammered in the same way, but the leaves are thicker. The latter is called party gold. Both are used by artists and gilders, and by druggists to gild pills, &c.

Gold, Powdered. *Syn.* DIVIDED GOLD, GILDING POWDER, GOLD BRONZE, GOLD COLOUR; AURI PULVIS, L. *Prep.* 1. Gold, 1 part; mercury, 7 parts; form an amalgam, and expose it to heat until all the mercury is volatilised; or dissolve out the mercury with hot nitric acid. In either case the residue is to be powdered, washed, and dried. If the quantity operated on is considerable the process should be so conducted as to save the mercury.

2. From gold-leaf and honey ground together, as the last, by means of a stone and muller. This is the plan commonly adopted in the small way by artists.

3. From a solution of gold in aqua regia precipitated by protosulphate of iron, the resulting powder being washed, dried, and gently heated. This gives pure gold.

Uses, &c. Powdered gold is employed in gilding by japanners and by artists. It is either sold in powder (gold in powder), or made up into shells (gold in shells). Its use in medicine has been already noticed.

Gold, Chlorides of:

1. **Monochloride.** AuCl. *Syn.* AUROUS CHLORIDE, PROTOCHLORIDE OF GOLD. A yellowish-white mass formed when a solution of trichloride of gold is evaporated to dryness, and the residuum is exposed to a temperature of about 440° F., until fumes of chlorine cease to be evolved. It is insoluble in water, which decomposes it, slowly when cold, but rapidly when hot, into metallic gold and the trichloride.

2. **Trichloride.** $AuCl_3$. *Syn.* AURIC CHLORIDE, TRICHLORIDE OF GOLD; AURI CHLORIDUM, L. *Prep.* Gold, 1 part, is dissolved by the aid of heat in nitro-hydrochloric acid, 8 parts, and the solution is evaporated nearly to dryness, and allowed to crystallise.

Prop. Orange-red crystalline needles, or ruby-red prismatic crystals; deliquescent; solu-

ble in water, ether, and alcohol, forming a deep yellow solution; at 500° F. it suffers decomposition, chlorine being given off and pure gold left behind. It is reduced by ferrous sulphate, oxalic, sulphurous, formic, and phosphorous acids, as well as by most of the metals, to metallic gold. It combines with several of the metallic chlorides, forming a series of double salts, which are mostly yellow when in crystals, and red when deprived of water.

Uses, &c. It has been employed by Duportal, Chrestein, Niel, Cullerier, Legrand, and others, as a substitute for mercury, in scrofula, bronchocele, chronic skin diseases, &c.; also as a caustic.—*Dose*, $\frac{1}{20}$ gr., dissolved in distilled water, or made into a pill with starch; or, in frictions on the gums, in quantities of $\frac{1}{16}$ to $\frac{1}{10}$ gr. Its most important use, however, is as a reagent in *photography*, large quantities being manufactured for use as a chief agent in toning photographic prints.

To some extent it is also used for electro-gilding, and mixed with excess of bicarbonate of potassium it forms a good gilding solution for small articles of copper. These are first cleaned with dilute nitric acid, and then boiled for some time in the mixture.

The above is the salt generally referred to under the name of the 'chloride of gold.'

Gold, Chloride of, and Sodium. $AuCl_3.NaCl.2Aq.$ *Syn.* AUROCHLORIDE OF SODIUM; SODII AUROCHLORIDUM, L. *Prep.* Auric chloride, 85 parts; chloride of sodium, 16 parts; dissolve in a little distilled water, evaporate until a pellicle forms, then put the solution aside to crystallise. It forms beautiful orange-coloured rhombic prisms. It is used in *medicine* in the same way as the trichloride.

Gold, Cyanide of. $AuCy_3$. *Syn.* AURIC CYANIDE. *Prep.* Add a solution of pure cyanide of potassium to a solution of pure auric chloride as long as a precipitate forms, carefully avoiding any excess; wash, and dry the precipitate.

Prop., Uses, &c. The salt is a pale yellow powder, insoluble in water, but very soluble in a solution of cyanide of potassium, forming the double cyanide of gold and potassium so largely used in the electrotype process. Cyanide of gold is employed to a certain extent in *medicine.*

Gold, Fulminating. *Prep.* By adding ammonia to a solution of gold in aqua regia (trichloride) as long as a reddish-yellow precipitate (fulminating gold) forms; the latter must be collected, washed, and dried with the greatest possible caution.

The chlorine of the gold chloride is replaced by the group NH_2. See FULMINATING COMPOUNDS.

Gold, Iodide of. AuI_3. *Syn.* AURIC IODIDE, TRI-IODIDE OF GOLD; AURI IODIDUM, L. *Prep.* Add a solution of trichloride of gold to one of iodide of potassium. The resulting precipitate is at first redissolved on agitation, a soluble double iodide being formed; subsequently the iodide of gold is precipitated, leaving the supernatant liquor colourless.

Prop., Uses, &c. A dark green powder, easily soluble in hydriodic acid. It is occasionally employed as a medicine, and, like other preparations of gold, is of an alterative character.—*Dose*, About $\frac{1}{16}$ gr.

Gold, Oxides of:

1. **Monoxide.** Au_2O. *Syn.* AUROUS OXIDE, PROTOXIDE OF GOLD. *Prep.* Formed by treating the aurous chloride with strong potassium hydrate. A green powder, somewhat soluble in potassium hydrate solution, and readily decomposing into metallic gold and auric oxide.

2. **Trioxide.** Au_2O_3. *Syn.* AURIC OXIDE, OXIDE OF GOLD, PEROXIDE OF GOLD, AURIC ACID; AURI OXIDUM, L. *Prep.* Magnesic oxide, 4 parts; auric chloride, 1 part; water, 40 parts; mix, boil, and wash the precipitate with water, dilute nitric acid, and again with water. It must be dried in the shade.

A reddish-yellow powder, easily decomposed by heat; readily soluble in hydrochloric and hydrobromic acids and strong nitric acid, but insoluble in water and the other acids. It forms unstable salts with the alkalies.

Gold, Sulphide of. Au_2S_3. *Syn.* SULPHURET OF GOLD; AURI SULPHURETUM, L. *Prep.* Transmit a current of sulphuretted hydrogen gas through a solution of trichloride of gold in water; or add hydrosulphide of ammonia to the same solution; collect the precipitate, wash it with cold distilled water, and dry it in the shade.

GOLD'BEATER'S SKIN is prepared from the peritoneal membrane of the cæcum of the ox. It is used to separate the leaves of gold whilst under the hammer, as a nearly invisible defensive dressing for cuts, as a fabric for court plaster, &c.

GOLD DETER'GENT. *Prep.* (*Upton.*) Take quicklime, 1 oz.; sprinkle it with a little hot water to slake it, then gradually add boiling water, 1 pint, so as to form a milk. Next dissolve pearlash, 2 oz., in boiling water, $1\frac{1}{2}$ pints; mix the two solutions, cover up the vessel, agitate occasionally for an hour, allow it to settle, decant the clear, put it into flat half-pint bottles, and well cork them down.

Use. To clean gilding, &c., either alone or diluted with water. It is applied with a soft sponge, and then washed off with clean water. It is essentially a weak solution of potassa, and may be extemporaneously prepared by diluting solution of potassa (Ph. L.) with about 5 times its volume.

GOLD SHELLS. Gold-leaf or powdered gold ground up with gum-water, and spread upon the insides of shells. Used by artists.

GOLD SIZE. *Syn.* GILDING SIZE, GILDER'S S., GOLD COLOUR. *Prep.* 1. (OIL SIZE.) Drying or boiled oil thickened with yellow ochre or calcined red ochre, and carefully reduced to the utmost smoothness by grinding. It is thinned with oil of turpentine. Improves by age. Used for oil gilding.

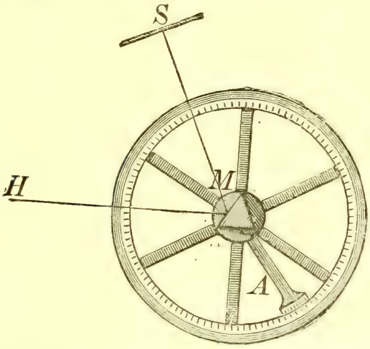
2. (WATER SIZE.) Parchment or isinglass size, mixed with finely ground yellow ochre. Used in burnished or distemper gilding.

GOLDEN SEAL. See HYDRASTIS CANADENSIS.

GONG-METAL. See BELL-METAL.

GONIOMETER. An instrument for measuring the angles of crystals—a matter of much importance in *chemistry* and *mineralogy*. The simplest form of instrument for this purpose is the reflecting goniometer of Dr Wollaston. It consists of

a horizontal graduated circle divided at its border into 360°; at its middle is a small plate (M), which revolves, and with which an indicator (A), pointing to the divisions, is connected. The crystal is placed upon the plate (M) in such a position that its angles and polished surfaces are vertical. A small beam of the parallel rays of the sun is re-



flected from the anterior surface and forms a bright vertical line upon a screen (S) placed at the side. The indicator (A), and with it the prism, is now turned until a second surface of the prism reflects the rays in the same direction—that is to say, until the bright line occupies the same position on the screen. The second surface must now of course occupy the same position as the first was in previously. If the second surface is parallel to the first, it is obvious that the indicator must revolve through 180° to bring the bright spot to the same place, but if the second surface forms with the first any angle a, the object is attained by a revolution of $180 - a°$. To find the angle of the prism a, therefore, it is only necessary to subtract the angle of revolution of the indicator, which can be read off on the divisions of the circumference, from 180° ('Optics and Light,' *Lommel*, 'Int. Scientific Series'). The angle of a prism may also be measured still more conveniently by means of a spectrometer, in which the indicator of the goniometer is replaced by an arm bearing a telescope.

GOOSE. Formerly, almost miraculous virtues were attributed to this bird. Its flesh was said to promote longevity, to cure hydrophobia, and to be aphrodisiac. The fat (GOOSE GREASE; ADEPS ANSERIS), mixed with honey, was supposed to be "good against the bitings of a mad dog." At the present day it is occasionally used in clysters, and, when scented, as a pomade to make the hair grow, for which purpose it is said to be superior to bear's grease. In quantity it is an emetic of very easy action. The large feathers of the wings (quills) are used for writing. The small feathers form the common stuffing of our beds.

GOOSE'BERRY. The fruit or berry of *Ribes grossularia.* Unripe fruit, cold and acidulous; ripe fruit, wholesome and slightly laxative; but the seeds and skins should not be eaten, as they are very indigestible; the juice of the green fruit is made into wine (ENGLISH CHAMPAGNE); the seeds, washed and roasted, were formerly used as a substitute for coffee (GOOSEBERRY COFFEE). Gooseberries are preserved by simply bottling them, and keeping them in a very cold place. See CHEESE, FOOL, FRUIT, &c.

GOULARD. *Syn.* GOULARD'S EXTRACT. See SOLUTION OF DIACETATE OF LEAD.

GOUT. *Syn.* ARTHRITIS, L. A painful disease that chiefly attacks the male sex, particularly those of a corpulent habit and robust frame. Persons who live temperately and take much exercise are seldom troubled with gout. Indolence, inactivity, luxurious habits of life, and free living, are among the exciting causes of this disease; but true gout may be seen among the very poor; and excessive study, grief, watchfulness, exposure to cold, and the too free use of acidulous liquors also occasionally bring it on. In some persons it is an hereditary disease.

Treatm. A plain or vegetable diet, moderate exercise, and the use of warm laxatives, gentle tonics, diaphoretics, and diuretics, abstinence from malt liquors and effervescing wines, are among the best preventives. The moderate use of alkaline remedies, as potassa and magnesia, has also been recommended. To relieve the fit of gout, or to check it at its commencement, the affusion of cold water will be often found effective. The use of the *eau médicinale,* or the *vinum colchici,* of the Pharmacopœia, may also be had recourse to; a due dose of which taken at bed-time will frequently carry off the paroxysm, and nearly always mitigate the symptoms. The effects of the above remedies do not greatly differ from each other. The action of both medicines is accompanied with great languor, and a deadly nausea or sickness, which terminates in vomiting or a discharge from the bowels, or both. These symptoms have often reached an alarming extent, and in some constitutions follow even a moderate dose. This method of cure should not, therefore, be unadvisedly and incautiously adopted.

Another remedy which has been recommended for gout is lemon-juice, but experience has proved that this agent is not to be depended on. The dose proposed by Dr O. Rees, who originated this treatment, was 2 or 3 fl. oz., twice or thrice a day.

To ensure the efficacy of lemon-juice, it must be expressed from the fruit into the glass shortly before being taken. That purchased at the shops is generally stale and disagreeable, and is often worse than useless. In some cases it is advisable to take the juice undiluted, but the more common practice is to mix it with about an equal quantity of water. See RHEUMATISM, COLCHICUM, DRAUGHT (Antiarthritic), LEMON-JUICE, VINEGAR OF COLCHICUM, WINE OF COLCHICUM, &c.

Gout Cor'dial. *Prep.* Rhubarb, senna, coriander seed, sweet fennel seed, and cochineal, of each, 2 oz.; liquorice-root and saffron, of each, 1 oz.; raisins, $2\frac{1}{2}$ lbs.; rectified spirit of wine, 2 galls.; digest for 14 days, press and filter. Used in gout and rheumatism. Aromatic and slightly laxative.—*Dose,* 1 to 3 table-spoonfuls.

Gout Med'icine. (*Duncan's.*) A mixture of wine of colchicum, wine of opium, and tincture of saffron.

Gout Rem'edy. (*Alexander's.*) According to Dr Paris, this contains aniseed, cumin seed, ginger, hermodactyls, pepper, and scammony.

Gout Specif'ic. (*Murray's.*) A mixture of iodide

of potassium, sulphate of magnesia, and wine of colchicum, disguised with an aromatic tincture.

GOUTTES AMÈRES. [Fr.] See DROPS (Bitter).

GRAD'UATOR. See VINEGAR.

GRAFT'ING COM'POST. Clay tempered with water, to which a little linseed oil is sometimes added. Used to cover the joint formed by the scion and stock in grafting.

GRAINS OF PAR'ADISE. *Syn.* GUINEA GRAINS, MALAGUETTA PEPPER. The seeds of the *Amomum melegueta.* Grains of paradise are hot, acrid, and aromatic, and in general properties similar to the other peppers. In some parts of the world they are used as a condiment. They are principally employed in these countries to impart a false strength to wine, beer, spirits, and vinegar.

GRAM or CHICK PEA (*Cicer arietinum,* L.). An annual herb, cultivated from an early period in warm countries, especially in India, where it is used in cakes, curries, &c. It was known to the ancient Egyptians, Hebrews, and Greeks. An acid liquid is obtained by collecting the dew from the plant in the early morning; it contains oxalic, acetic, and perhaps malic acid in solution. The Persian weight nukhud, $\frac{1}{114}$ oz. avoirdupois, is a seed of *Cicer arietinum.*

GRAM, GREEN. Of India (*Phaseolus Mungo,* L.), largely cultivated under various forms as a food crop. Flour and cakes are made from it. The seeds of *P. Mungo,* var. *radiatus,* are used in India, under the name of oord grains, each equalling a $\frac{1}{4}$ of a retti, or about $\frac{1}{2}$ a grain.

GRAM, HORSE. See DOLICHOS.

GRANIL'LA. A small inferior variety of cochineal (which *see*).

GRANULA'TION. The act or process of forming, or breaking into, grains or small masses.

The granulation of MEDICINES has of late years received considerable attention from both foreign and British pharmaceutists. In France, granulated powders (POUDRES GRANULÉES) are coming into general use in place of impalpable powders, the most unpleasant of all forms of medicine. The French process consists in enveloping the particles of medicines in syrup by means of heat and constant stirring. Mr Banner, of Liverpool, has lately introduced a method of granulating medicines far preferable to that of the French pharmaceutists. The powder to be granulated is placed in a mortar, and mucilage of gum-acacia is gradually added until a crumbly mass is made; this is then rubbed through a wire-sieve (about 12 meshes to the inch), and the granules produced are spread out on paper, and left to dry spontaneously, or they are placed in a copper pan, and kept in constant motion over a stove until dry; when perfectly dry, they are placed in a mortar, and sufficient quantity of strong tincture of tolu (3 dr. to 1 oz.) is added to them, until by constant stirring they all appear glossy and shining; they are then dried again by a gentle heat, being kept in constant motion. The granules thus formed keep well, are tasteless, and are much more elegant and agreeable preparations than pills or ordinary powders. Many saline substances are granulated by the simple process of dissolving the salt in water, and evaporating to dryness with constant stirring.

METALS are granulated (reduced to drops, grains, or coarse powder) by pouring them, in the melted state, into water. In many cases they are allowed to run through the holes of a species of colander or sieve to produce minute division; and in order to render the drops spherical, they are allowed to fall from a sufficient height to permit of their acquiring the solid state before striking the water. Lead shot is made in this way. Shot towers are often upwards of 100 feet in height.

GRAPES. *Syn.* UVÆ, L. The fruit of *Vitis vinifera,* or the common grape-vine. Ripe grapes are cooling and antiseptic, and in large quantities diuretic and laxative. They are very useful in bilious affections and dyspepsia, and in all febrile, putrid, and inflammatory complaints. The skin and seed, which are indigestible, should be rejected. "Grapes which contain a large quantity of sugar are, if taken without the husks, the safest and most nutritive of summer fruits" (*Cullen*). "The subjects of pulmonary affections who pass the summer in Switzerland may try the effects of a course of grapes, *cure de raisins,* a remedy held in high estimation in several parts of the Continent" (*Sir J. Clark*).

Grapes, in bunches, are preserved by wrapping them in silver paper, and packing them in dry bran. Each bunch is suspended by the stem with the fingers of one hand, whilst the bran is poured round it with the other; the jar being occasionally gently shaken as the process of packing proceeds. Some paper is then laid over the top of the jar, the mouth or cover of which is, lastly, tied firmly over with a bladder, to exclude the air and moisture. See FRUIT, &c.

GRAPH COMPOSITION. *Prep.* 1. Russian glue, 2 parts; distilled water, $1\frac{1}{2}$ parts; glycerin (1·260), 5 parts; all by weight. Soak the glue in the water, and, when soft, dissolve in the glycerin by the aid of heat. One part of fine whiting may be added if desired.

2. Nelson's gelatin, 3 oz. Soak in 4 oz. of water for 12 hours, then add glycerin, 2 oz., and heat gently until dissolved. Pour while hot into square wooden or tin trays.

GRA'PHITE. See PLUMBAGO.

GRAPHOLITHA PISANA, Curtis. The Pea Moth. It is very usual to find many of the peas in the pods at harvest-time, and even while still green, half eaten, and surrounded with little particles of dust and dirt. In some instances as many as 20% are thus affected, to the great loss of weight and injury to the appearance of the samples. Much loss is sustained very frequently from this by seed-pea growers. Crops of valuable seed-peas, worth from 10*s.* to 15*s.* per bushel, have been much injured by this pest in recent seasons in the pea-fields in Kent, Essex, Surrey, Bedfordshire, and Lancashire, as well as in market-garden farms, and in market gardens, and their value greatly reduced. The peas that are attacked cannot all be cleaned from the bulk, and buyers naturally think that the plants were unhealthy, and that it is dangerous to sow the seed. Sometimes the work of this moth is attributed to

weevils and beetles, the *Sitonæ* and *Bruchidæ*. It is, however, entirely of a different character from this, and is done at another period. This insect is well known in France and Germany.

Life History. This moth is a pretty little insect belonging to the family *Tortricidæ*. It is dusky grey in colour, with wings slightly tipped with white. It flies in the evening, and may often be seen in large numbers upon tares and sainfoin, though it has not been ascertained actually that it attacks these plants in the same way as peas. It places two or three eggs upon the young pods before the calices have fallen. From these pale green, rather inclining to yellow, caterpillars come and pierce their way into the pods, and then bore into the tender peas. They are about four lines long, or a little over a quarter of an inch, when full grown, having several pairs of legs. When the peas get hard the caterpillars fall to the ground, and getting below the surface enwrap themselves in silken cocoons, in which they remain until they change to pupæ in the spring. Some of the caterpillars remain in the pods and haulm and are carried with the peas.

Prevention. Peas should not follow peas in the course of cropping on farms, or in market gardens and gardens, after an attack of this moth. After the peas have been carried in infested fields a horse-rake should collect the pieces of haulm left upon the ground, which should at once be burnt. The land must be deeply ploughed. When the peas are thrashed out at once it would be well to burn the 'cavings' and rubbish; this should by no means be carried out to sheep in folds. In farms and market gardens where peas are picked green for market, it is important that infested haulm should be got off directly the peas are picked, and carted away or burnt. A good dressing of lime or lime ashes is a good means of prevention ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

GRAV'EL. A collection of small pebbles commonly mixed with sand or clay, or both. Gravel for garden walks is chosen for its fine colour and binding properties. The gravel of Kensington and Wimbledon is esteemed the finest in the world. Gravel walks, when once in order, may be rendered nearly equal to asphalt by pouring over them tar or a mixture of tar and pitch, absorption being promoted, if required, by the application of a hot iron.

Gravel. In *pathology*, a term popularly applied to calculous matter formed in the kidneys, and passing off in the urine; and sometimes to distinct calculi or concretions in the bladder itself.

An attack of gravel, as commonly understood, is accompanied by a deposit of red, gritty, sand-like particles in the urine, which do not dissolve when the urine is heated. The deposit consists of uric acid. Pains in the loins are a common accompaniment of gravel, and there is also sometimes pain in passing water.

Treatm. Give 20 minims of solution of potash (of the B. P.) 3 times a day in barley water; or 20 gr. of bicarbonate of soda, also 3 times a day. Vichy water will also be found a useful remedy. See CALCULUS.

GRAVIM'ETER. See HYDROMETER.

GRAV'ITY. *Syn.* GRAVITATION. The attractive force by which bodies fall towards the centre of the earth. Weight is the measure of gravity. The determination of the relative weight of bodies with reference to a given standard is explained under SPECIFIC GRAVITY.

GRA'VY. The juice or liquid matter that drains from dressed meat after it is placed on the dish for serving. The common practice among cooks is to pour a spoonful or two of boiling water or broth over the joint, to increase the quantity. The natural gravy that oozes from the meat after it is cut is the richest and most wholesome. Made gravies are prepared by adding spice and flavouring to the foregoing, or to strong meat soup.

The gravy for roast meat is usually made by sprinkling a little salt on the joint after it is placed in the dish, and then pouring some boiling water over it; this washes off some of the brown, and makes a coloured liquid in the dish.

Another method for making a gravy for roast meat is the following:—Take any bones, scraps of cold meat, or trimmings of the joint, put them in ½ pint of water, with a little salt and ½ an onion, let them stew all the time the meat is roasting; colour with a little burnt sugar. When the meat is done, pour the dripping from it carefully into a basin, leaving the gravy at the bottom of the tin; strain the gravy you have made into this, let it boil, and pour round (not over) the meat. If the gravy is liked thick, put one dessert-spoonful of flour, mixed into a smooth paste, with two of cold water, into the saucepan 5 minutes before you stain it. See SAUCE.

GRAY. *Syn.* GREY; GRIS, Fr. A mixture of black and white. Delicate greys result from mixture of the three elementary colours—red, yellow, and blue—in which the blue preponderates to a greater or less extent.

GRAY DYE. *Syn.* TEINTE GRISE, Fr. Gray is dyed with the same materials as black, but both the bath and mordant are used in a more diluted state. COTTON goods may be worked in sumach and then in copperas; this gives rather a bluish-gray, which may be modified to any particular hue by the addition of suitable colouring matter. To make it yellowish, a small amount of fustic and alum are employed; to make it 'fuller,' peach-wood and Lima-wood with alum are used. The methods of obtaining gray on SILK and WOOL are very numerous; they are similar in principle to the above, all depending on the blending of the three primary colours, or on the modification of weak blacks. See BLACK DYE.

GREASE. A general term applied to soft animal fats; as BEAR'S GREASE, GOOSE GREASE, &c.

Grease. An inflammatory affection of the heels of horses, which produces dryness, scurfiness, and stiffness. The *treatment* consists of emollient poultices, accompanied with physic and diuretic balls, to subdue the inflammation, followed by mild astringent lotions or ointments.

GREAVES. *Syn.* GRAVES. The sediment of melted tallow, consisting chiefly of animal membranes mixed with fat, made up into cakes. Used as a coarse food for dogs.

GRE'CIAN WATER. See HAIR DYES.

GREEK FIRE. This compound, so much used in ancient warfare, is believed to have had naphtha for its chief ingredient. According to some authorities, it was a mixture of asphalt, nitre, and sulphur.

GREEN. *Syn.* VIRIDIS, L.; VERT, Fr. Of the colour of the leaves of growing plants; *subst.* a green colour.

GREEN DYE. *Syn.* TEINTE VERTE, Fr. All the green dyes in use, with the practically unimportant exception of Chinese green and oxide of chromium green, are compounded of blue and yellow. The goods, in practice, are generally dyed blue first, observing to regulate the shade according to that of the intended green; they are then dried, rinsed, and passed through a yellow bath, with the like precautions, until the proper shade is obtained. See BLUE DYE, YELLOW DYE, &c.

GREEN PIG′MENTS. Several of the green pigments of commerce are obtained from copper. Oxide of chromium furnishes some which are very beautiful. Many are formed by the mere mechanical admixture of blue and yellow pigments. The bright blues and yellows, when mixed in this way, produce the liveliest greens; orange, or red and blue, and the yellowish-browns and blue, the more dingy greens. In this way are produced all the extemporaneous greens of the artist. Nickel and titanium also furnish green colours, but these are not in common use. The following list embraces all the best known and most useful green pigments:

Green, Arsen′ical.—Arsenite and aceto-arsenite of copper. See GREEN, SCHEELE'S and SCHWEINFURT (*below*).

Green, Barth's. From yellow lake, Prussian blue, and clay, ground together.

Green Bice. Same as mountain green.

Green Bremen. This is properly green verditer, but other preparations are frequently sold under the name.

Green, Brighton. A mixture of impure acetate of copper and chalk, prepared as follows:

To sulphate of copper, 7 lbs., add sugar of lead, 3 lbs.; each separately dissolved in water, 5 pints; mix the solutions, stir in of whiting, 24 lbs., set the resulting paste on chalk stones, and when dry grind it to powder.

Green, Brunswick. This is probably a crude chloride of copper, but a mixture of carbonate of copper and alumina or chalk is now commonly sold under the name in the shops.

Prep. 1. A saturated solution of sal ammoniac, 3 parts, is poured over copper filings or shreds, 2 parts, contained in a vessel capable of being closed up, and the mixture is kept in a warm place for some weeks, when the newly formed green pigment is separated from the unoxidised copper by washing the mixture on a sieve; it is then edulcorated with water, and slowly dried in the shade. Colour very deep and rich. The lighter shades are produced by the addition of sulphate of baryta.

2. A solution of crude carbonate of ammonia or bone spirit is added to a mixed solution of alum and blue vitriol, as long as it affects the liquor; in a short time the precipitate is collected, washed, and dried. The various shades of green are produced by using different quantities of alum, which pales and cheapens it.

Green, Chrome. The superb green pigment used by enamellers under this name is the green oxide or sesquioxide of chromium. A hydrated oxide of chromium forms the emerald green of Pannetier; it is prepared by melting in a crucible equivalent quantities of anhydrous boracic acid and bichromate of potassium, and treating the fused mass with water. The hydrated oxide thus produced is washed and finely triturated.

The chrome green of the oil and colour shops is a mixture of chrome yellow and Prussian green.

Green Cop′per. Green bice or mountain green, Brunswick green, emerald green, verditer, and several other well-known pigments, may be thus named.

Green, Em′erald. This term is commonly applied to the aceto-arsenite of copper, as prepared in England. It is the same compound, chemically speaking, as Schweinfurt green (which *see*).

Prep. A pulp is formed with verdigris, 1 part, and boiling water, q. s., and after being passed through a sieve, to remove lumps, is added gradually to a boiling solution of arsenious acid, 1 part, in water, 10 parts, the mixture being constantly stirred until the precipitate becomes a heavy, granular powder, when it is collected on a calico filter, and dried on chalk stones.

Green, Frise. *Syn.* FRIESLAND GREEN. This resembles Brunswick green.

Green, Gellert's. A mixture of cobalt blue and flowers of zinc with some yellow pigment.

Green, Impe′rial. Schweinfurt green (see *below*).

Green, Iris. A pigment prepared by grinding the juice of the petals of the blue flag with quicklime. It is very fugitive.

Green, Lake. See LAKE.

Green, Min′eral. This is the same as mountain green.

Green, Mitis. Another of the many synonyms of Schweinfurt green.

Green, Mountain. This pigment is properly the native green carbonate or bicarbonate of copper (malachite) ground to powder, either with or without the addition of a little orpiment or chrome yellow. That of the shops is commonly prepared by adding a solution of carbonate of soda, or of potassa, to a hot mixed solution of sulphate of copper and alum. Green verditer is commonly sold for this article. According to Watts, mountain green is the same as Neuwieder green.

Green, Neuwieder. Schweinfurt green mixed with gypsum or sulphate of baryta.

Green, Prussian. The sediment of the process of making Prussian blue from bullock's blood or horns, before it has had the hydrochloric acid added to it. It is also prepared by pouring hydric chloride upon freshly precipitated Prussian blue. As now sold, this pigment is generally a mixture of Prussian blue and gamboge.

Green, Rinman's. This resembles that of Gellert.

Green, Sap. A very fugitive pigment, prepared from the juice of buckthorn berries. The berries are allowed to ferment for a week or eight days

in a wooden tub. The juice is then pressed out, strained, a little alum added, and the whole evaporated to a proper consistence; it is next run into pigs' bladders, and hung up in a dry situation to harden. An inferior article is made from the juice of black alder and of evergreen privet. It is a common practice to add $\frac{3}{4}$ pint of lime water and $\frac{1}{2}$ oz. of gum-arabic to every pint of either of the above juices.

Green, Scheele's. This is arsenite of copper.

Prep. 1. White arsenic (in powder), 1 part; commercial potash, 2 parts; boiling water, 35 parts; dissolve, filter, and add the solution gradually, whilst still warm, to a filtered solution of sulphate of copper (cryst.), 2 parts, as long as a precipitate falls; lastly, wash the newly formed pigment with warm water, and dry it.

2. (*Ure.*) Powdered arsenious acid, 11 oz.; carbonate of potassa, $1\frac{1}{2}$ lbs.; boiling water, 1 gall.; dissolve, filter, and add the solution as before to another solution of crystallised sulphate of copper, 2 lbs., in water, 3 galls. *Prod.*, $1\frac{1}{2}$ lbs. A very fine grass-green colour.

Green, Schweinfurt. This splendid green pigment is the aceto-arsenite of copper.

Prep. 1. Acetate of copper and arsenious acid, equal parts, are each dissolved separately in the least possible quantity of boiling water, and the solutions mixed whilst still as hot as possible; an olive-green precipitate falls, which, by being boiled in the liquor 5 or 6 minutes, changes to a dense granular powder of a superb green colour.

2. Instead of boiling the solution containing the precipitate, it is allowed to cool and stand for several hours, or until the powder assumes a granular and beautiful tint. Very rich.

3. (*Kastner.*) Arsenious acid, 8 lbs., is dissolved in water as before, and added to verdigris, 9 or 10 lbs., diffused through water, q. s., at 120° F., the pap of the other being first passed through a sieve; the mixed ingredients are then set aside till the mutual reaction produces the proper shade.

4. (*Dr Ure.*) Sulphate of copper, 50 lbs., and lime, 10 lbs., are dissolved in good vinegar, 20 galls., and a boiling hot solution of white arsenic, 50 lbs., is conveyed as quickly as possible into the liquor; the mixture is stirred several times, and then allowed to subside, after which it is collected on a filter, dried, and powdered. The supernatant liquor is employed the next time for dissolving the arsenic.

5. See GREEN, EMERALD (*above*).

Obs. This is a very fine, permanent green pigment. "A great deal of needless alarm has been excited about its supposed deleterious effects. It is extensively employed for staining wall-papers, and persons inhabiting rooms thus papered are said to have had their health seriously deranged by the arsenical fumes evolved from it. Now, it is utterly impossible that arsenic could volatilise from such a compound at ordinary temperatures; it does not decompose at any temperature below redness" (Watts). [It is, however, probable that the air of such apartments is sometimes charged with the poisonous pigment through its becoming mechanically detached from the paper. To breathe an atmosphere so impregnated would be dangerous. The use of papers coloured with Scheele's green, especially of the kind called 'flock,' should, therefore, be carefully avoided.—ED.]

Verd'igris. See COPPER (Acetates) and VERDIGRIS.

Green Verd'iter. This is essentially a mixture of oxide and carbonate of copper, in uncertain proportions, with chalk. Factitious green bice and mountain green have a like composition. See VERDITER.

Green, Verona. The mineral called green earth.

Green, Vienna. The same as Schweinfurt green.

GREEN-SICKNESS. See CHLOROSIS.

GREGORY'S SALT. The crude hydrochlorate of morphia, prepared by Gregory's process. It is a double hydrochlorate of morphia and codeia.

GRENADE SOLUTION. The solution placed in hand-grenades for extinguishing fires is said to have the following composition:—Chloride of calcium, 18·329; chloride of magnesium, 5·7; chloride of sodium, 1·316; bromide of potassium, 2·179; chloride of barium, 0·265; water, 72·211, with traces of iron and aluminium chlorides.

GRINDELIA ROBUSTA. A perennial plant belonging to the Nat. Ord. COMPOSITÆ; a native of California, in which state it is largely used against poisoning by the 'poison oak' (the *Rhus toxicodendron*). Of late years it is said to have been used in American medical practice with excellent effect in asthma and kindred diseases. Dr Q. C. Smith, writing to the 'Pacific Medical and Surgical Journal' for April, 1875, states that one patient to whom pills made of the solid extract were administered had suffered from severe and frequent attacks of asthma since childhood, and had found no relief from various remedies. Dr Smith gave his patient the extract of the grindelia in pills of 3 gr. each, one 3 times a day for 2 or 3 days, then a pill at bedtime only, for 8 or 10 days longer. Under this mode of treatment the attacks are said to have been much less severe and less frequent; the patient not only gaining in strength and general health in the meantime, but having experienced an immunity from attack for 4 months. The parts of the plants used are the selected leaves and tops.

GRIND'ING. The operation of reducing substances to powder by attrition or friction. In the laboratory the term is chiefly applied to powdering by means of a mill or by mechanical power, in opposition to simple pounding or trituration in a mortar, or with a slab and muller. All the principal powders, paints, &c., sold by the druggist, drysalter, and colourman are reduced in the drug or colour mill. Recently machinery has even been applied to the common mortar. An ingenious and very useful contrivance of this kind is the 'mechanical mortar' of Mr H. Goodhall, of Derby.

GRIND'STONES (Artificial). Washed siliceous sand, 3 or 4 parts; shell-lac, 1 part; melt together, and form the mass into the proper shape whilst warm, with strong pressure. The fineness of the sand must depend on the work the stone is intended for. The same composition is formed upon pieces of wood, as corn rubbers, and for the purpose of sharpening knives, and cutting stones, shells, &c. See EMERY.

GROATS. *Syn.* Grits; Grutellum, Avena decorticata, Avenæ semina, Avena (Ph. L.), L. Common oats, deprived of their exterior integuments or husks. This is generally effected in a mill, which at the same time cuts them into two or three pieces. When crushed flat they are denominated Embden groats.

GROUT. Mortar reduced to a thin paste with water; used to fill up the joints of masonry and brickwork. A finer kind is used to 'finish off' the best ceilings.

GRUEL. *Syn.* Oatmeal gruel, Water g.; Decoctum avenæ, L. Oatmeal or groats boiled with water to a proper consistence, and strained. It is variously flavoured to suit the palate; but the addition of a little white sugar and finely powdered Jamaica ginger, with or without a glass of wine, is the least likely to offend the stomach. Nutmegs, cinnamon, &c., frequently disagree with invalids. Sometimes milk or butter is added. Embden groats require less boiling than the common groats. Of oatmeal the Scotch is commonly said to be the best.

The following directions for making gruel from oatmeal are given by Dr A. T. Thomson:—"Oatmeal, 2 oz.; cold water, $1\frac{1}{2}$ pints; rub the meal in a basin with the back of a spoon in some of the water, pouring off the fluid after the grosser particles have subsided, but whilst the milkiness remains; repeat this with fresh water, unite the washings, and boil until a soft, thick mucilage is formed."

GRYLLOTALPA VULGARIS, Latr. The Mole Cricket. This is the largest insect common to Great Britain, and though it cannot be said to be very destructive to farm crops, it lives entirely upon roots and stems under the ground, and devours indiscriminately those both of cultivated and wild plants. It is abundant in some districts, preferring sandy and peaty soils. Notes have been sent as to injury caused to pasture-land in Bedfordshire and in Ireland. This was at first attributed to the larvæ of the Daddy Long-legs, *Tipula oleracea,* but on further inquiry it was proved that the mole crickets were the offenders. The roots of the grasses had evidently been bitten through and through, and the most succulent parts eaten, and the ground was strewn with dying and dead herbage in patches here and there.

Again, an observer noticed that wheat-plants had been attacked in a light loamy soil in Kent, as he said, in a manner different from any attacks he had noticed before. Upon careful search he discovered mole crickets. Injuries to peas and beans have been traced to these insects, for they were seen emerging from the ground in pea- and bean-fields for their summer life. Kirby and Spence speak of them as troublesome to cultivators ('An Introduction to Entomology,' by W. Kirby and W. Spence). Köllar states that they do much damage to young corn in Germany, and in France they are much dreaded by farmers and gardeners.

Life History. The perfect insect is rather over 2 in. in length. It is brown or chocolate, becoming rather ochreous under its body. The elytra are whitish, and the wings are also whitish, membranous, and ample when spread. Curtis says that this constitutes the sole difference between the sexes, though Taschenberg holds that there are slight distinctions in the arrangement of the 8 rings of the body. The fore-feet are very stoutly made, proportionally short, but very strong and thick, like those of the mole, admirably suited for burrowing in the ground. They can fly, jump, and dig, and possess the power of running backwards as well as forwards, to facilitate which the end of the abdomen is furnished with 2 bristles, or filaments, to serve the same purpose as antennæ or feelers.

In May and the early part of June the female lays from 200 to 300 eggs of an ovoid shape, and dirty yellow colour. Latreille says from 200 to 400 are laid by one female. These are placed in a cluster, within a nest a few inches under the ground 'in a kind of chamber,' as Gilbert White describes it in his 'Natural History of Selborne,' 'with many caverns and winding passages.' There is a communication between the nest and the surface by means of a passage. From the eggs larvæ come resembling black ants, which begin to feed at once upon roots of corn-plants, grasses, and vegetables. These have no wings, but grow fast, moulting 4 or 5 times until they are about $1\frac{1}{4}$ in. in length. They remain in this state for 3 years, and in November go down deeply into the earth away from the effects of cold.

Prevention. In meadows and pastures watering with liquid manure, in which there is an infusion of quassia, would tend to prevent egg-laying. Dressings with earth, ashes, and sawdust mixed with petroleum would also clear the insects away from their accustomed haunts.

Remedies. When it is found that these insects are present in corn-land, thorough cultivation would disturb them. It must be remarked that they are principally found in small fields and plots. Where they attack peas and beans frequent hoeing routs them; and it will be found that dressings of ashes, mould, or sawdust mixed with paraffin would be very useful, in the proportion of 1 quart of oil to 1 cwt. of ashes or mould, and 3 pints or 2 quarts to 1 cwt. of sawdust, as these insects are very sensitive of smell. In meadows where their presence is denoted by withered and yellow patches, waterings with infusions of quassia mixed with a little soft soap would keep the larvæ from the surface ('Report on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

GUACO. See Aristolochia.

GUA'IACIN. *Syn.* Guaiacic acid, Pure guaiacum resin. A substance having the nature of an acid, discovered by Trommsdorff in the wood and bark of *Guaiacum officinale.*

Prep. The tincture of guaiacum is treated with hydrate of lime, and the guaiacate of lime thus formed is decomposed with dilute sulphuric acid; it is purified by dissolving it in alcohol.

Prop., &c. Insoluble in water; soluble in alcohol and ether; it unites with the caustic alkalies, forming alkaline guaiacates (guaiacum soaps); air and light turn it green; gluten, mucilage of gum-arabic, &c., turn it blue; nitric acid and chlorine turn it successively green, blue, and brown; tincture of guaiacin, added to hydrocyanic acid and sulphate of copper, produces an intense blue colour (*Pagenstecher*). A delicate

photographic paper may be formed by washing unsized paper with an alcoholic solution of guaiacum resin, and afterwards with one of neutral acetate of lead (*Johnston*).

GUAIACOL. One of the constituents of creosote, and may be obtained from it by fractional distillation, also by submitting guaiacum to dry distillation, the tar obtained being subsequently treated with soda solution and distilled. The residue in the retort is treated with sulphuric acid, and again distilled. The oily distillate is treated with alkali and acid as before, by which means the guaiacol is obtained, and may be purified by repeated distillation. It has been recommended as a substitute for creosote, especially in the treatment of phthisis.

GUA'IACUM. *Syn.* GUAIAC, GUM-GUAIACUM, GUAIACUM RESIN; GUAIACUM (Ph. L.), GUAIAC RESIN, GUAIACA RESINA (B. P.). The resin prepared by means of fire from the wood of *Guaiacum officinale*, or of *G. sanctum*, by natural exudation, by incision, or by heat (B. P.). This substance is often adulterated. When pure, its "fresh fracture is red, slowly passing to green; the tincture slowly strikes a lively blue colour on the inner surface of a thin paring of raw potato" (B. P.). Adulteration with resin may be generally discovered by the odour evolved when the guaiacum is heated. An alcoholic tincture of guaiacum, rendered milky with water, recovers its transparency on the addition of caustic potassa in excess; but this is not the case when resin is present.

Guaiacum is stimulant, sudorific, and alterative. —*Dose*, 10 to 30 gr., either in powder or pills; in chronic rheumatism, gout, obstinate chronic skin disease, scrofula, syphilis, &c. It forms the active ingredient of the once celebrated 'CHELSEA PENSIONER,' and the 'GOUT SPECIFIC' of Mr Emerigon. The latter was made by digesting 2 oz. of guaiacum resin in 48 fl. oz. of rum for 7 or 8 days. The dose of this was a table-spoonful every morning, fasting, for a twelvemonth. Its other properties are similar to those of GUAIACIN, but are less marked. Sp. gr. 1·20 to 1·22.

Guaiacum Wood. *Syn.* LIGNUM VITÆ, GUAIACI LIGNUM (Ph. L.), L. The wood of *Guaiacum officinale*, or of *G. sanctum*. This is employed under the form of shavings, raspings, and sawdust, in decoctions only. See DECOCTION and BALSAM.

GUANO. [From Peruvian *huana* (=dung).] It consists of the consolidated excrement of sea-fowl, and is only found to any great extent in the 'rainless' districts of the world. The earliest known deposits occur on the coast of Peru and the outlying islands. Those on the Chincha Islands, now nearly exhausted, were originally 200 ft. thick, and formed at one time the chief source of this manure. Guano was introduced into England in 1841 by the Earl of Derby, and since that time has been largely used as an artificial manure; it is now obtained from Peru, and also from Chili, Bolivia, Patagonia, Texas, Labrador, Curaçoa, Cuba, Australia, the Ichalve Islands, Malaya, Kooria Mooria, &c.

Guano is a substance of very complex composition, but its value as a manure depends upon the amount of phosphate of lime and nitrogenous substances which it contains. The deposits now worked are on the whole not so rich in nitrogen as those which have been exhausted; some deposits even, known as '*guano-phosphates*,' contain practically no nitrogen; they are found on coral islands in the South Pacific, and are guano out of which the soluble matters have been washed by the sea. Those varieties which are poor in nitrogen are sometimes mixed with ammonium sulphate in order to make their percentage of nitrogen equal to that of the best Peruvian guano, which they then equal in quality, and are at the same time much cheaper than the latter; they are sold as 'ammoniated Peruvian guano.' The amount of phosphoric acid in guano varies usually from 10% to 16%; that of nitrogen from 5% to 8%. The market price varies from £9 to £13 per ton. Peruvian guano varies in colour from light fawn to dark brown; it occurs both in lumps and in powder, and contains the following substances:—Calcium phosphate, calcium carbonate, ammonium-magnesium phosphate, guanine, alkali salts, phosphate, urate, and chloride of ammonium, &c. The strong odour of damp guano is due to ammonium carbonate, which it loses by volatilisation.

Since the introduction of guano into England in 1841 the quantity imported increased till 1870, but since then has decreased, owing to the inferior quality of the material, and to the use of ammonium sulphate and mineral phosphates as sources of nitrogen and phosphoric acid for various crops.

Guano imported in	1841	=	1,733	tons.
,, ,,	1853	=	12,316	,,
,, ,,	1870	=	280,000	,,
,, ,,	1880	=	79,000	,,
,, ,,	1881	=	50,000	,,

For an exhaustive series of analyses of guano from different sources the reader is referred to the excellent treatise of Dr A. B. Griffiths on 'Manures' (Whittaker, London, 1889), from which the present article is largely compiled. Summing up the results of these analyses, Dr Griffiths says—1. There is great variation in the composition of guanos. Hence they should always be bought with a guaranteed analysis. 2. In the comparatively recent deposits (such as Angarnos and Ichalve guanos) the percentage of nitrogen is much higher than in older deposits. 3. Some guanos are nitrogenous as well as phosphatic manures, whilst others (as the guanos from Pacific Ocean islands) are only phosphatic manures. 4. On an average guano contains about 3% of potash, which is also a valuable plant-food. The quantity of guano usually applied varies from 2 to 5 cwt. per acre.

The guanos from the north coast of Peru, and as far south as the Chincha Islands, are rich in nitrogen and comparatively poor in alkalies, while the guanos exported from the Peruvian islands south of Chincha contain considerable quantities of alkaline salts and smaller percentages of nitrogen.

Guano is the most important of all the artificial fertilisers of the soil. The nitrogenous varieties contain considerable quantities of phosphoric acid in a soluble form as ammonium phosphate, and their value, as already mentioned, depends chiefly

upon the phosphoric acid and nitrogenous constituents which they contain. The late Mr Nesbit estimated that 1 ton of nitrogenous guano was equal to 33½ tons of good farmyard manure, or 21 tons of horse-dung, reckoning their value by the amount of nitrogen which they contain. The greater part of the *nitrogen* contained in Peruvian guanos is in the form of uric acid and its salts, but small quantities exist as the base guanine, &c. This nitrogen is almost immediately available as plant-food, and is considered by some to have equal value with the nitrogen of the salts of ammonia, if not with sodium nitrate. The *phosphoric acid* of these guanos exists chiefly as finely divided calcium phosphate, but some of it is in combination with alkalies like potash or soda. It is stated that for some years past the importations of Peruvian guano have varied much in composition. Very little has reached our shores containing more than 8% of ammonia, but the Peruvian guanos now in the market are richer in phosphates than formerly. Peruvian guano has some advantages over most other unmixed manures containing the same quantity of nitrogen and phosphoric acid; the reason being that it contains the nitrogen and phosphates in different degrees of solubility, so that it supplies the plants' requirements more slowly and evenly through their period of growth than can be done by manures in which the nitrogen and phosphoric acid are contained each in some *one* form of combination.

Nitrogenous (Peruvian) guanos form excellent manures for cereal, root, and potato crops. Sir J. B. Lawes recommends 2 to 3 cwt. of guano per acre for wheat crops, this quantity to be sown broadcast and harrowed into the land before sowing the seed. Sometimes it is best used as a top-dressing in the spring, being sown broadcast over the young wheat-plants at the rate of 2 to 4 cwt. per acre. It is a good practice to dress the land with these ammoniacal guanos in damp weather, so that the rain may distribute them equally in the land. When guanos are mixed with superphosphate of lime the mixture forms an excellent top-dressing for grass lands. Composts of guano with good quality soils are made and used for clovers as well as grass lands. The following mixture forms a good compost:—3 cwt. of genuine guano, 12 cwt. of soil.

From 10 to 15 cwt. per acre of this mixture should be sown broadcast in the spring. For turnip crops 3 to 5 cwt. of guano per acre forms an excellent manure, especially on clayey soils.

No fixed rules can be given as to what lands will be most benefited by dressings of guano. It is of great use upon both light and heavy soils. The Peruvians have used it in their naturally barren, sandy, and clayey soils with remarkable success, so much so that any person found destroying the sea-fowls (whose excrement forms the guano) suffers the penalty of death. It may be said, however, generally, that Peruvian guanos are better suited to heavy lands than to light soils, and on these latter soils they may be used wastefully, owing to the poor absorbing power of the soil for the volatilised ammonia; they are best applied on such light soils in the form of composts. Peruvian guano is also not very suitable for chalk or limestone soils; on these soils nitrogen should be applied in the form of sodium nitrate, for there is then no loss by volatilisation.

The late Mr Nesbit recommended Peruvian guano for turnips, and preferred to apply "two thirds of the guano broadcast, and one third in drill with the seed." Of course, if a soil is deficient in potash no amount of guano will produce a full crop of turnips, because these crops require, in addition to phosphates, potash manure. The ash of turnips yields—

	Roots.	Leaves.
Potash (K_2O)	50·1%	27·9%
Phosphoric acid (P_2O_5) .	16·4%	4·2%

Hence, if potash already exists in a certain soil, and guano is applied to that land, the want of alkali in the manure is supplied by the potash in the land; every fertilising property is now present in a high degree, and a good crop will be obtained. If, however, the soil is deficient in potash, the crops, if manured with guano alone, will certainly be unremunerative; the cereals will be deficient in grain—all stem with ears alarmingly light; potatoes all haulm, with insignificant tubers; beans all stalk and no seed; and turnips all tops and no bulbs; in fact, just the reverse of what the farmer desires. The farmer who uses guano will save much expense and labour by observing the above few facts before applying it to his land, instead of, as is still frequently done, applying it indiscriminately to all varieties of soils, irrespective of the organic and inorganic substances which they already contain.

Good and Adulterated Guanos.

	Good.		Adulterated.	
	I.	II.	III.	IV.
Water	12·42	12·00	5·33	8·28
Organic matter and ammonia salts	52·98	59·11	3·52	13·11
Iron oxide and alumina	—	—	—	3·59
Calcium phosphate .	25·06	19·31	18·10	2·35
Calcium sulphate (gypsum)	—	—	—	15·17
Calcium carbonate (chalk)	—	—	69·75	8·00
Sodium chloride (salt)	—	—	1·75	15·80
Magnesia	—	—	1·35	—
Sand, &c.	1·50	1·45	—	34·29
Alkaline salts . . .	8·26	8·13	0·20	—
	100·22	100·00	100·00	100·59
Ammonia yielded by the organic matter and ammonia salts . .	17·21	19·30	0·23	0·64

Adulteration of Guanos. Guanos, owing to their high price, are greatly adulterated. The materials used for adulterating them are sand, clay, gypsum, salt, powdered bricks, and limestone;

imitation Ichalve guanos have even been made of the same colour as the genuine article, and with feathers added. Sometimes Peruvian guanos are adulterated with cheap mineral phosphates in a finely ground state. Such phosphates, though not without value as manures, have not the same agricultural or money value as the phosphates, &c., contained in genuine Peruvian guano. The foregoing table gives some analyses of good and adulterated guanos.

In the above analyses the nitrogen is very high in samples I and II, and low in III and IV. No. III has been adulterated with chalk or limestone; No. IV with gypsum, salt, and sand. Many persons are under the impression that by obtaining guano direct from the vessel they are certain of procuring the genuine article; but this is not the case, for ship after ship has been sent out to the guano deposits ballasted with gypsum. Further comment is needless.

The farmer must beware, not only of adulteration, but also of the so-called '*official analyses*' by which Peruvian guanos are generally sold. These are the original tests made on the arrival of each cargo, and by these the price is generally fixed. But these 'official analyses' are made from samples from which the stones have been picked out, and therefore show higher percentages than the guano when sold in its natural state to the agriculturist. Farmers should therefore beware of guanos with stones, and a guarantee given on 'official analysis.'

In selecting a guano the following points (*Anderson*) ought to be attended to by the farmer:

"1st. The guano should be light coloured and dry, colouring very slightly when squeezed together, and not gritty.

"2nd. It should not have too powerful an ammoniacal smell, and should contain lumps which, when broken, appear of a paler colour than the powder.

"3rd. A bushel should not weigh more than from 56 to 60 lbs.

"These characters are, however, imitated with great skill, so that they cannot be implicitly relied upon, and they are applicable to Peruvian guano only."

Testing Guanos. The following are a few *simple tests*, by means of which the farmer can ascertain to some extent the quality of the guano he uses:

1. Peruvian guano, when burnt, leaves a perfectly white ash if it is pure. If adulterated with sand, marl, powdered bricks, clay, &c., the ash is more or less of a reddish-brown colour.

2. If, on the addition of strong hydrochloric acid (muriatic acid) to the ash, there is an effervescence (liberation of carbonic acid), the guano has been adulterated with chalk, limestone, or marl. If there is no effervescence it does not contain either of these substances.

It must be borne in mind that these are but very crude tests. They would not, for instance, show the admixture of a mineral phosphate, free from iron, with Peruvian guano.

Pure guano has a pale brown colour, a more or less offensive odour, and the average sp. gr. of 1·63 to 1·64. If the sp. gr. exceed 1·75, it is either damaged or adulterated; and if it is less than 1·62, it contains an undue quantity of moisture. The best is neutral to test-paper, and sometimes has even an acid reaction; but that of commerce has generally an alkaline reaction, owing to the presence of free ammonia, and, in consequence, turns turmeric paper brown, and gives white fumes when a glass rod dipped in hydrochloric acid is held over it. Triturated with quicksilver or caustic potassa, good guano evolves a powerful odour of ammonia; digested in water, fully $\frac{1}{2}$ of it is dissolved; and dried by the heat of boiling water, it does not lose more than from 7% to 9% in weight.

Analysis of Guanos. The following method of carrying out a complete analysis of guano is extracted from Professor Percy Frankland's 'Agricultural Chemical Analysis,' Macmillan, London, 1883:

Guano is generally of a dark brown colour, and consists of a light powder, with very friable lumps interspersed; these lumps on being fractured should exhibit white spots and crystalline structures.

As the guano is generally very far from homogeneous, a considerable quantity should be taken and well mixed, so as to render it of uniform composition.

According to their origin and subsequent decomposition, or owing to additions which have been purposely made by manufacturers, the composition of commercial guanos is subject to great variations, more especially in the amount of phosphoric acid which they contain. In most cases the determination of phosphoric acid and nitrogen is sufficient to fix the commercial value of the guano, but in the following the complete analysis of Peruvian guanos is described, which may have to be slightly modified for other varieties according to the ingredients found in the qualitative examination of the guano.

1. *Water.* 2 to 3 grms. of the finely powdered guano are dried on a watch-glass at 100° C. (212° F.) until of constant weight. Guano of good quality should not contain more than 14% to 18% of moisture.

The escaping aqueous vapour carries with it in the above operation a little ammonia, the loss of which may even amount to more than 1%. If, therefore, a more accurate determination of the moisture is required, the operation of drying must be carried out so that the aqueous vapour is drawn through a measured quantity of standard sulphuric acid; from the amount of the acid neutralised, as determined by titration, the weight of ammonia evolved is calculated, and subtracted from the loss of weight on drying at 100° C. standard alkali; the true percentage of water in the sample is thus ascertained.

2. *Mineral and Organic Matters.* 5 grms. are weighed into a crucible, and ignited until the residue is quite incinerated, and then weighed again.

Good Peruvian guano yields about 36% of a white or light grey ash; a much higher percentage of ash than this is indicative of adulteration, and a yellow or reddish ash points to admixture of loam, the ashes of peat, &c.

3. *Sand, &c.* The ash obtained in No. 2 is

heated in a beaker with hydrochloric acid, a little nitric acid, and water (much effervescence is indicative of adulteration or inferior quality), until everything but the siliceous particles is dissolved; this residue is filtered off, washed, ignited, and weighed.

The filtrate, after separating silica by evaporation with hydrochloric acid in the usual way, is made up to 300 c.c., and employed for the determination of phosphoric acid, alkalies, and sulphuric acid.

4. *Phosphoric Acid.* It is often necessary, in the accurate determination of phosphoric acid, to fuse the guano with a mixture of dry sodic carbonate and potassic chlorate. The hydric-calcic phosphate so frequently present in the different varieties of guano is, by ignition, converted into pyrophosphate, which is then only gradually reconverted into orthophosphate by solution in acids, occasioning great inaccuracy in the determination of the phosphoric acid, especially with the uranic nitrate method. There is least error when the ammonic molybdate method is employed, as the solution is then heated with nitric acid for several hours. It is therefore advantageous, in determining phosphoric acid in all guanos, to take a special portion and ignite it with 2 parts of dry sodic carbonate and 1 part of potassic chlorate. In the analysis of substances such as bone-dust, animal charcoal, &c., which on ignition yield a carbonaceous residue rich in nitrogen and combustible only with difficulty, the potassic chlorate may with advantage be replaced by potassic nitrate, which continues to give off oxygen at higher temperatures.

2 grms. of the substance are ignited with 3 times their weight of the above mixture in a platinum crucible at a gentle heat. As soon as the contents of the crucible are white the heat is increased, and the mass fused for a $\frac{1}{4}$ of an hour at a red heat. After cooling, the crucible is placed in a beaker and covered with 100 c.c. of water; 23 c.c. of nitric acid (sp. gr. 1·25) are then added, the beaker being partially covered with a clock-glass. The silica is separated by evaporation in the usual way, and the filtrate is made up to 300 c.c. The phosphoric acid is determined in 50 c.c. with ammonic molybdate, or by titration with uranic nitrate; in the latter case, if ferric phosphate is precipitated from the acetic acid solution, it must be collected on a filter and estimated separately.

5. *Phosphoric Acid, Lime, Magnesia, and Ferric Oxide.* 200 c.c. of the filtrate obtained in No. 3 are rendered weakly alkaline with ammonia in the cold, and the precipitate formed is dissolved in acetic acid without heating; any ferric phosphate remaining undissolved is filtered off, ignited, and weighed, and the *ferric oxide* and *phosphoric acid* calculated. In the strongly heated filtrate the *lime* is precipitated with ammonic oxalate, filtered off, and estimated. The filtrate from the lime is rendered alkaline with ammonia, and the precipitated *ammonic-magnesic phosphate* filtered off and weighed, while the remaining phosphoric acid is precipitated in the filtrate from this with magnesic mixture.

6. *Alkalies and Sulphuric Acid.* 100 c.c. of the filtrate obtained in No. 3 are heated nearly to boiling, and a slight excess of baric chloride added; the precipitated baric sulphate is filtered off and weighed. In the filtrate the greater part of the free hydrochloric acid is eliminated by evaporation; the liquid is then diluted and rendered alkaline with baric hydrate. The precipitate is filtered off, and the filtrate treated with ammonic carbonate and oxalate to remove the lime and excess of baryta. After filtration the alkaline chlorides are determined by evaporating the filtrate, then the potassium as potassium-platinic chloride, and the sodium by difference.

7. *Carbonic Acid.* A separate portion is treated in one of the forms of apparatus used to determine carbonic acid. See CARBONIC ACID.

8. *Matters Soluble in Water.* 5 grms. of the finely powdered and homogeneous guano are extracted with 100 c.c. of water for a quarter of an hour at a temperature near the boiling-point. The insoluble residue is collected on a tared filter, dried at 100° C. (212° F.), and weighed.

The loss consists of—

(*a*) Moisture.

(*b*) Matters soluble in water.

If the moisture found in No. 1 be subtracted from this loss the difference gives the proportion of matters soluble in water, which in good Peruvian guano amount to about 36%.

It must be remarked that if the above extraction with water be continued only for a short time the proportion of ammonic oxalate dissolved is greater, whilst that of ammonic phosphate and sulphate is less; whilst if the duration of the extraction be extended the amount of oxalic acid dissolved diminishes, and that of ammonic phosphate increases. The small quantity of ammonic chloride and sulphate present in the guano tends to bring the calcic phosphate into solution, which is then decomposed by the ammonic oxalate with precipitation of calcic oxalate and formation of soluble ammonic phosphate.

9. *Nitrogen.* A soda-lime combustion (see NITROGEN) is made with 5 grms. of guano, the latter being mixed with the soda-lime in the combustion-tube by means of a wire stirrer, and not in an open mortar, otherwise loss of nitrogen as ammonia would occur.

The ready-formed ammonia can be estimated by Schlösing's method. Some of the guano is placed in a small dish, and this, together with another dish containing a known volume of standard acid, is placed under an air-tight bell jar; some aqueous potash is then added to the guano, and the jar quickly closed down and left for two days. By titrating the acid in the dish with standard alkali the amount of ammonia absorbed is ascertained.

10. *Uric Acid.* The residue insoluble in water obtained in No. 8 is gently heated with a dilute solution of caustic soda and filtered; the filtrate is then acidulated with hydrochloric acid. The precipitated uric acid is collected on a tared filter, dried at 100° C. (212° F.), and weighed.

11. *Oxalic Acid.* The carbonic acid is expelled from a separate portion of the guano by treatment with dilute sulphuric acid; the latter is then neutralised with caustic soda (free from carbonate), and then mixed with pure peroxide of manganese. The whole is then introduced into a

carbonic acid apparatus and sulphuric acid added; the oxalic acid is decomposed with evolution of carbonic anhydride, the quantity of which is determined by loss in the usual way. From the carbonic anhydride evolved the oxalic acid is then calculated.

$$\left\{\begin{matrix} CO(OH) \\ CO(OH) \end{matrix}\right. + MnO_2 + SO_2(OH)_2 = SO_2(MnO_2) + 2OH_2 + 2CO_2.$$

GUARANA (*Grimault & Co.*, Paris). 12 migraine powders, each weighing 1·75 grms., consisting of guarana, but perhaps also containing an admixture of cocoa seeds, neither prepared nor roasted (*Hager*).

GUARA'NA. *Syn.* PAULLINIA, BRAZILIAN COCOA. An alimentary and medicinal substance prepared from the seeds of *Paullinia sorbilis*, a Brazilian climbing shrub.

What is commonly known as guarana, guarana bread, or Brazilian cocoa, is prepared from the seeds as follows:—In October and November, at which time they become ripe, the seeds are removed from their capsules and sun-dried, so as to admit of the ready removal by hand of the white ovule; they are next ground in a stone mortar or deep dish of hard sandstone; the powder is moistened by the addition of a small quantity of water or by exposure to the dew; it is then made into a paste with a portion of whole or broken seeds, and worked up into balls, but usually in rolls 5 in. to 8 in. in length, 12 oz. to 16 oz. in weight: after drying by artificial or solar heat the product is packed between broad leaves in sacks or baskets. Thus prepared it is of extreme hardness, has a brown hue, and a bitter astringent taste. An inferior kind, softer and of a lighter colour, is manufactured by admixture of cocoa.

Rasped or grated guarana in sugar and water forms a beverage largely consumed in Brazil and other parts of South America. In Mexico the root is used more frequently than the powdered seed, and the natives extol it highly in the treatment of dysentery; some of the lower class make a tea from the roots, and use it in the same way as sassafras in this country.

Dr Martin in 1840 discovered a new principle, which he called guaranin, which he claims is identical with caffein, and is used in the hospitals for the same purpose.

Dr Austin, in an article in 'Braithwaite's Retrospect,' says it is practically a convenient form of impure caffein; it was first prescribed as a medicine in 1817. Some chemists claim they have obtained as much as 6% of caffein, which is more than that from any other substance; its therapeutic action is lauded for its prompt relief of headache. In England it is in popular repute as a stomachic febrifuge, more especially in dysentery and diarrhœa; in the last disease it is used in doses of 1 dr. In 1872 it was used in the treatment of migraine; in 1873 for lumbago; in 1874 in sciatica and blennorrhœa.

A tincture made with 80% alcohol, 2 oz. of the guarana to the pint, gives a precipitate, while one made with strong alcohol and glycerine keeps clear.

A good fluid extract guarana may be made as follows:— Powdered guarana, 16 oz.; alcohol, 8 fl. oz.; glycerine, 4 fl. oz.; water, 4 fl. oz. Mix alcohol, glycerine, and water together; macerate the guarana in it for 24 hours; express; pack the guarana in glass percolator; pass through the expressed liquor until 12 fl. oz. are obtained (displace with dilute alcohol until 16 oz. have passed); reserve the first 12 oz.; evaporate the 16 oz. of dilute alcohol that have passed through to 4 oz.; mix with the reserve. The U.S. Pharmacopœia recommends 3 parts of alcohol to 1 of water.

Elixir of guarana: Guarana, powdered, 4 oz.; alcohol, 6 fl. oz.; water, 6 fl. oz.; glycerine, 6 fl. oz.; oil of orange, 8 drops; oil of cinnamon, 1 drop. Exhaust by percolation to 15½ fl. oz.; to this add the oils dissolved in ½ oz. of alcohol; mix and filter. Each teaspoonful represents 15 gr. of active constituent of guarana.

GUARA'NIN. A crystalline substance discovered by M. Martin in guarana. It appears to be identical with caffein, the active principle of coffee and tea.

GUD'GEON. The *Cyprinus gobeo*, Linn., a small fresh-water fish, common almost everywhere. The white is considered the best. It was formerly used in medicine.

GUINEA-WORM (*Filaria dracunculus*). A nematoid parasite, 1 ft. to 3 ft. in length, and about 1-10th in. in breadth. The history of its development is rather obscure, the mode being as yet unknown. The Russian traveller Fedschenko says the first stage is passed in the body of minute aquatic crustacea (*Cyclops*), which are taken into the human stomach in drinking water. It grows in the human body to full size, boring its way through the flesh to the surface.

The native treatment, viz. catching one end of the worm and slowly rolling it round a stick, thus dragging it out of the flesh, is the only effectual cure.

GUM. *Syn.* GUMMI, L. The general term for an important class of vegetable products. Gums are more or less soluble in cold water, but insoluble in alcohol, ether, and oils. They are obtained from certain plants in amorphous masses; most of them exude spontaneously, or on puncturing the bark. The most perfect type of this class is the substance called GUM-ARABIC, or GUM ACACIA. The gums are employed as demulcents in medicines, and are used as cements, and for giving stiffness and gloss to textile fabrics. By the public the term is often incorrectly applied to the resins and gum-resins.

Gum Acacia. *Syn.* GUM-ARABIC; ACACIÆ GUMMI (B. P.), G. ARABICUM, G. ACACIA, ACACIA (Ph. L.), L. "From various species" (of *Acacia*) "yielding gum" (Ph. L. & E.), chiefly *Acacia senegal.* "Whitish or yellowish, transparent or cracked on the surface, and opaque; brittle; it dissolves freely in water" (Ph. L.). It is scentless, and may be bleached by exposure to the sun and air at the temperature of boiling water. Sp. gr. 1·355 (*Ure*). The pure soluble principle of gum-arabic is termed ARABIN (which *see*). BARBARY or MOROCCO GUM and EAST INDIA GUM are inferior commercial varieties of the same substance from other species of *Acacia* (see *below*).

Powdered gum-arabic (PULVIS ACACIÆ) is frequently adulterated with flour or farina, or with other inferior gums. The first may be detected by agitating a little of the powder with cold

water; the pure gum dissolves rapidly, whilst the starch or flour falls to the bottom of the vessel: or a little of the powder may be mixed with boiling water, and, when cold, tested with tincture of iodine; if it contain starch or flour the paste will assume a blue colour. If it contains cherry-tree gum or tragacanth it will be only partly soluble in cold water, and the paste will be partly coloured, and more or less interspersed with gelatinous clots.

For the detection of dextrin in gum-arabic Hager finds that when some of the adulterated article is placed in a glass dish with vertical sides, and a solution of ferric chloride, density 1·48, diluted with an equal volume of water, is poured over it until the grains are just covered, in the course of a minute or so particles of gum-arabic will adhere to the bottom of the vessel, whilst the grains of dextrin do not.

Ordinary solutions of gum-arabic, however concentrated, fail in their adhesive power in many cases, such as in joining together wood, glass, or porcelain. The addition of 1% of crystallised aluminium sulphate overcomes this objection, and produces a solution meeting all requirements.

Much of the white gum-arabic of the shops is formed by bleaching gum Senegal, by what is called 'Picciotto's process.' The gum is dissolved in water, and sulphurous acid gas passed through the solution. The liquid is afterwards boiled to expel the sulphurous acid, a little of which, however, still remains behind. To obtain the gum in a still whiter state carbonate of baryta is added, and after agitation the mixture is filtered; it is afterwards shaken with gelatinous alumina, again filtered, and evaporated. The product (BLEACHED GUM) is very white, but lacks the peculiar toughness and adhesiveness of the best gum acacia.

Gum, Barbary. *Syn.* MOROCCO GUM. An inferior product, consisting of a mixture of several acacia gums. It is exported from Mogador.

Gum, Bassora. A solution of yellowish gum brought from the neighbourhood of Bassora. It differs from most gums in being nearly insoluble in water. The plant yielding it is believed to be a species of *Mimosa.* It contains the principle BASSORIN, which also exists in gum tragacanth.

Gum, Bleached. See GUM-ARABIC (*above*).

Gum, Brit'ish. *Syn.* DEXTRIN, STARCH GUM. Starch converted by the action of acids, diastase, or heat into a soluble substance resembling gum.

Prep. 1. Malt (crushed small), 1 lb.; warm water, 2 galls.; mix, heat the whole to 145° F., add of potato starch, 5 lbs., raise the heat to 160° or 165° F., and mash for about 25 minutes, or until the liquid becomes thin and clear; it must then be instantly run off, and raised to the boiling-point to prevent the formation of sugar; after boiling for 3 or 4 minutes the whole must be filtered, and evaporated to dryness by a steam heat.

2. By exposing dry potato starch, in a stove, to a heat of about 400° F. Yellow and inferior.

3. (*M. Payen.*) Dry starch, 1 ton, is moistened uniformly with concentrated nitric acid, $4\frac{1}{2}$ lbs., (diluted with) water, q. s., and the paste or dough is made up into small bricks or loaves, and dried in a stove; it is next reduced to coarse powder, and exposed in a stove-room for some time to a current of air at 160°—165° F.; it is next ground, sifted, and exposed, as before, to a heat of about 228° F.; it is, lastly, ground and passed through the 'bolting machine.' Very white and superior. This process has been patented in France by M. Henzé.

4. (*Pinel.*) Water, 100 galls.; nitric acid, $\frac{1}{2}$ gall.; and hydrochloric acid, $\frac{1}{2}$ pint, are mixed together, and so much potato starch is mixed as will form a thin paste; in 2 hours the liquid is drained off, and the solid matter is made up into lumps, which are dried by a gentle heat in a stove-room; they are next coarsely pulverised, and the powder is exposed on three successive days to the respective temperatures of 100°, 150°, and 190° F.; the whole is then sifted, and, lastly, exposed to a heat ranging from 300°—350° F. Darker coloured than the last. To give it the appearance of gum-arabic, it is made into a paste with water containing 1% of nitric acid, and after being spread on copper plates in layers $\frac{3}{4}$ to 1 in. thick it is exposed to a stove heat ranging from 240°—300° F.

Prop., *&c.* White; insipid; transparent; friable; soluble in cold water, and in dilute spirit; insoluble in alcohol and ether; its solution yields a precipitate with acetate of lead. Iodine commonly turns commercial dextrin blue, but does not affect the colour of pure dextrin. It is distinguished from ordinary gum by its right-handed polarization of light, and by yielding oxalic but not mucic acid when treated with nitric acid.

Dextrin is nutritive, emollient, and agglutinant. In France it is largely employed by the pastry-cooks and confectioners, and in medicine as a substitute for gum. The French surgeons also commonly employ it as a 'stiffening' for the splints used for fractured limbs. In this country it is chiefly used as a fine dressing for muslins, silk, and other textile fabrics, and in calico-printing. Recently it has been made up into tear-like masses and sold for gum-arabic, to which, however, it is vastly inferior as an agglutinant. See DEXTRIN.

Gum, Cherry-tree. *Syn.* FRUIT-TREE GUM, PLUM-TREE G.; GUMMI CERASI, G. PRUNI, L. An exudation from the stems of cherry, plum, and some other of the ROSACEÆ. It is only partly soluble in water. It contains CERASIN (which *see*).

Gums, East India. These are found in commerce under the names of 'Glassy Amrad,' 'East India Amrad,' 'Pale Amrad,' and 'Ghatti.' The sources of these gums are uncertain. They are darker in colour than gum acacia, and often mixed with pieces of gum, which swell to a jelly in water. Ghatti is considered to be the best of the E. I. gums, as it gives a very adhesive mucilage.

Gum, Hyawa (*Icica heptaphylla,* Aubl.). From British Guiana.

Gum, Insoluble. See BASSORA GUM, CHERRY-TREE GUM, and GUM TRAGACANTH.

Gum, Seed. *Syn.* GUMMI SEMINUM, L. A species of soluble gum extracted from the seed of the flax (linseed), quince, &c.

Gum Tragacanth. *Syn.* TRAGACANTH, GUM DRAGON; GUMMI TRAGACANTHA, G. DRACONIS,

TRAGACANTHA (Ph. L.), L. The gummy exudation of the *Astragalus gummifer*, hardened by the air. When digested in water it swells considerably, a portion is dissolved, and the whole combines to form a thick mucilage. It is totally soluble in boiling water, when some change is supposed to take place in it; a great portion, however, afterwards separates. Sp. gr. 1·384. It is chiefly employed in calico-printing, and by shoemakers and lozenge-makers; by the latter to give toughness to the saccharine mass.

Powdered tragacanth is often adulterated with flour of starch, and not unfrequently with the commoner varieties of gum-arabic. According to M. Planche, a mixture of pulverised tragacanth and gum-arabic forms, with water, a thinner mucilage than the same quantity of either of these gums alone. This fraud may be detected as follows:—Make a mucilage of the suspected gum, and add thereto a few drops (2 or 3 to the dr.) of alcoholic tincture of guaiacum, taking care to stir it all the while. If the sample contains any gum-arabic the mixture in the course of a few minutes assumes a fine blue colour, whilst it does not change colour if the gum tragacanth is pure. 5% of gum-arabic can be thus detected. When the quantity is very small, 1 to 4 hours may elapse before the colour is developed. Starch and flour are detected in the manner noticed under GUM-ARABIC.

Gum, Turkey. Various qualities of gum acacia are sold under this name.

GUM-RES'INS. *Syn.* GUMMI RESINÆ, L. Vegetable products in which the properties of gum and resin are combined. They are partly soluble in water, and partly in alcohol. Many of them form a species of emulsion when triturated with the former fluid. The principal gum-resins are AMMONIACUM, ASSAFŒTIDA, BDELLIUM, GALBANUM, GAMBOGE, MYRRH, OLIBANUM, OPOPONAX, SAGAPENUM, and SCAMMONY.

GUN-BAR'RELS. See BROWNING.

GUN-COT'TON. See PYROXYLIN.

GUN'JAH. See HEMP (Indian).

GUN-MET'AL. An alloy containing 90·5% of copper and 9·5% of tin, used for casting pieces of ordnance (erroneously termed 'brass guns'), also those parts of machinery which are subjected to considerable friction. See ALLOYS, BRONZE, STEREO-METAL, &c.

GUN'POWDER. This substance is a mechanical mixture of saltpetre, charcoal, and sulphur. It is seldom prepared on the small scale.

Prep. The saltpetre having been trebly refined by boiling, skimming, filtering, and crystallising, is melted into cakes, which are then brushed to remove any adhering grit or dirt, broken into pieces with a mallet, ground to a fine powder in a mill, and sifted through a fine bolting sieve of brass wire. The charcoal is that of the alder or willow, and is carefully burnt, as already described, and is then reduced to powder. The sulphur is refined by distillation, and ground to the same fineness as the charcoal and saltpetre. The ingredients are weighed out in the proper proportions and mixed together in a machine consisting of a wooden drum having a shaft passing through its centre, to which numerous 'flyers' in the shape of knife-blades are attached, the drum and flyers revolving in a contrary direction. When mixed, the charge is carried to the 'incorporating mill,' where it is ground under vertical iron 'mill-stones,' with a small quantity of distilled water, until the ingredients are thoroughly incorporated. The product of this operation is then pressed into a hard cake, which is next broken into pieces, granulated by means of sieves, and after being 'glazed' by friction and the dust separated, is dried, with proper precautions, in a stove heated to about 130° by steam pipes.

Major Cundill thus summarises the operations in the manufacture of gunpowder:

1. Mixing the previously purified and sifted ingredients to form a 'green' or 'unworked' charge.
2. Milling (incorporating) the mixture to form mill-cake ('ripe' or 'worked' charge).
3. Breaking down mill-cake. (This is omitted in many factories.)
4. Pressing.
5. Granulating or 'corning.'
6. Dusting.
7. Glazing.
8. Drying in a stove.
9. Finishing, or final dusting.

The proportions of saltpetre, charcoal, and sulphur, used for different kinds of powder, differ very slightly. In 'sporting powders' the proportion of saltpetre is generally from 1% to 3% greater than in the Government powders. In 'miners' powders' it is about 10% less, an excess of sulphur being used. The following are the proportions adopted by European powers:

	Saltpetre.	Charcoal.	Sulphur.
England	75	15	10
France	75	12·5	12·5
Austria	75	15	10
Prussia	75	13·5	11·5
Russia	73·78	13·59	12·63
Spain	76·47	10·78	12·75
Sweden	76	15	9

(Capt. Jervis-White Jervis.)

Obs. The quality of gunpowder is best estimated by actual trial of its power and cleanliness in use. It should be dry, hard, and free from dust; the grains should be of a uniform size, and glossy, and the colour a dark grey or brownish grey, not perfectly black. A very little placed on a piece of paper and fired should instantly explode with a flash, and neither leave an appreciable residue on the paper nor burn it. Dried by the heat of boiling water, or *in vacuo*, it should not lose more than ½% to 1% of its weight. Damp powder rapidly 'fouls' the gun. Gunpowder containing more than 7% of water does not recover its strength by simply drying it. The sp. gr. ranges between 1·795 and 1·800.

Karolyi succeeded in analysing the gases of gunpowder which had been fired in conditions closely resembling those which occur in artillery practice. For this purpose he enclosed a charge of powder in an iron cylinder of such strength that it just burst when the powder was fired by means of the electric spark. This charged cylinder was suspended in a hollow spherical bomb, from which the air was exhausted before firing.

After the explosion had been produced, the

gases and the solid residue of the powder were submitted to analysis. The results obtained were the following ('Phil. Mag.,' 1863):

1. *Composition of the Powder used.*

		Ordnance Powder.	Small Arms Powder.
	Nitre	73·78	77·15
	Sulphur	12·80	8·63
Charcoal	Carbon	10·88	11·78
	Hydrogen	0·38	0·42
	Oxygen	1·82	1·79
	Ash	0·31	0·28
		99·97	100·05

2. *Products of Combustion by Weight.*

		Ordnance Powder.		Small Arms Powder.	
Gaseous	Nitrogen	9·77	30·58	10·06	34·18
	Carbonic anhydride	17·39		21·79	
	Carbonic oxide	2·64		1·47	
	Hydrogen	0·11		0·14	
	Sulph. hydrogen	0·27		0·23	
	Marsh gas	0·40		0·49	
Solid	Ammonic sesquicarbonate	2·68	69·25	2·66	65·14
	Potassic sulphate	36·95		36·17	
	Do. carbonate	19·40		20·78	
	Do. hyposulphite	2·85		1·77	
	Do. sulphide	0·11		0·00	
	Charcoal	2·57		2·60	
	Sulphur	4·69		1·16	
	Loss	0·17		0·68	
		100·00		100·00	

3. *Products of Combustion by Volume in* 100 *of Gas.*

	Ordnance Powder.		Small Arms Powder.	
Nitrogen	37·58	100	35·33	100
Carbonic anhydride	42·74		48·90	
Carbonic oxide	10·19		5·18	
Hydrogen	5·93		6·90	
Sulphuretted hydrogen	0·86		0·67	
Marsh gas	2·70		3·02	

It will be seen from the above figures that, in addition to the generation of a considerable amount of carbonic anhydride (carbonic acid) by the combustion of gunpowder, there is liberated at the same time a large quantity of solid matter in the form of sulphate and carbonate of potash, sulphide of potassium, sulphur, charcoal, &c. This will explain why the air of mines is so prejudicial to the health of the miner, particularly when he is engaged in blasting operations, these being carried on in a more or less confined space. See AIR, VITIATED.

More recently ('Phil. Trans. of Roy. Soc.,' 1874, vol. ii, p. 49) Abel and Noble have published the results of experiments upon the combustion of gunpowder, under conditions similar to those which exist when it is fired in guns. Quantities of powder, varying from 100 to 150 grms., were fired by means of electricity in a strong steel vessel closed by a conical plug, and provided with two apertures, one communicating with an arrangement for allowing the gases to escape, the other containing an apparatus for determining the pressure of the gases at the moment of explosion. The pressures actually observed varied from 1 to 36 tons per square inch, the whole of the gaseous products remaining pent up in the cylinder under this enormous pressure. A spherical pellet powder, of Spanish manufacture, and four varieties of English military powder, viz. pebble, rifle large-grain (cannon), fine-grain, and rifle fine-grain powders, were experimented on. We have no space to give the actual numerical data, but the results of the investigation may be briefly summarised as follows:

1. The composition of the *gas* furnished by the explosion of all the English powders is remarkably uniform, but under high pressures the carbon dioxide increases, and the carbon monoxide decreases.
2. The composition of the *solid* products exhibits a much greater variation.
3. The decomposition which an average gunpowder undergoes, when fired in a closed space, cannot be represented by even a comparatively complicated chemical equation.
4. The volume of permanent gases measured at 0° C. and 760 mm., furnished by the combustion of 1 grm. of powder in a closed vessel, is about 280 c.c., and is therefore about 280 times the volume of the powder.
5. When 1 grm. of powder is burnt the solid products of combustion amount to 0·57 grm., and the permanently gaseous products to 0·43 grm.
6. The pressure of the products of combustion, when the powder entirely fills the space in which it is fired, is about 6,400 atmospheres, or 42 tons per square inch.
7. The heat developed by the burning of 1 grm. of powder is about 705 thermal units.
8. The total theoretic work of gunpowder, when indefinitely expended, is about 486 foot-tons per lb., or 332,000 grm.-metres per grm. of powder.
9. The temperature of explosion is about 2200° C. (4000° F.).

It was found that the very small-grain powders furnish smaller proportions of gaseous products than the large-grain powders, and these, again, smaller than pebble powder. The most important solid products are carbonate, sulphate, hyposulphite, and sulphide of potassium. The proportion of carbonate is much higher and of sulphate very much lower than was formerly thought to be the case.

Gunpowder, Schultze. This is intermediate between ordinary gunpowder and gun-cotton; it is light in colour, and gives but little smoke when fired. According to Cundill it consists of nitro-lignin mixed or impregnated with a nitrate or nitrates (other than nitrate of lead), and with or without starch or collodion (such collodion to consist of nitro-lignin dissolved in ether and alcohol), or solid paraffin free from mineral acid. A sample gave the following proportions:

Soluble nitro-lignin	24·83
Insoluble "	23·36
Lignin (unconverted)	13·14
Nitrates of potassium and barium	32·35
Paraffin	3·65
Matters soluble in alcohol	0·11
Moisture	2·56

The subjoined account of Schultze gunpowder is a transcription of a report communicated to the editor of the 'Field' newspaper by Mr F. Toms, A.I.C., F.C.S. After referring to a previous communication on the same subject Mr Toms proceeds as follows:—I have carried out some further experiments, with the aid (by Dr Frankland's kind permission) of apparatus more suited to my requirements than that previously at my disposal; and I now proceed to lay before you the results of these experiments, and the conclusions to which they have led me, respecting the powders formerly received and the new Schultze powder, with a sample of which you have since favoured me.

The main constituent of the Schultze gunpowder, as you are aware, is wood fibre, which, having first been purified, is then subjected to the action of strong nitric acid (intensified by mixture with sulphuric acid), and thus is converted into a kind of nitro-cellulose or pyroxylin, the ordinary form of which is gun-cotton. The wood fibre undergoes no change in appearance by this treatment; but a change takes place in its chemical composition, which may thus be exemplified:

	Cellulose (Unconverted Cotton or Wood Fibre).	Nitro-cellulose (Cotton or Wood Fibre treated with Nitric Acid).	
Carbon	6 parts	6 parts.	
Oxygen	5 „	5 „	
Hydrogen	10 „	7 „	or more.
Nitroxyl (NO_2)	none	3 „	or less.

It will thus be seen that the sole difference between gun-cotton or Schultze powder and ordinary cotton or wood fibre is that some of the hydrogen is abstracted, and has its place supplied by nitroxyl—a substance contained in nitric acid, and composed of 1 part of nitrogen united with 2 parts of oxygen. Under the most favourable circumstances it is possible to replace *three* of the ten parts of hydrogen by three of the nitroxyl, when the substance produced is explosive, and is called, from its composition, *tri*-nitro-cellulose. This is the purest form of gun-cotton. If weaker acid is used less hydrogen is displaced, and the product is called *di*-nitro-cellulose or *mono*-nitro-cellulose, according as it contains *two* or only *one* part of nitroxyl. These derivatives are either feebly explosive or not explosive at all. Such are the compounds known as photographic collodion and soluble gun-cotton, the latter name distinguishing it from pure gun-cotton, which is not soluble in a mixture of ether and alcohol.

The Schultze powder contains both the explosive and the non-explosive varieties of nitro-cellulose.

If the wood fibre, after being carefully purified according to the method described in Schultze's patent of 1864, were thoroughly desiccated and allowed to cool out of contact with air, and then dipped in acid of the strength mentioned in the specification, there seems no theoretical reason why an explosive powder containing at least 90% of true tri-nitro-cellulose should not be produced. As, however, I find on experiment that nothing like that percentage is arrived at, I can only conclude that, in order to moderate the violence of the explosion, the Schultze Company secure the formation of a large percentage of 'soluble' or less explosive nitro-compounds by merely air-drying their wood.

If this supposition be generally true, it seems probable that the sample of Schultze powder supplied by Messrs Blissett may owe its extra explosive force to exceptional care being taken, during the interval between the drying and the dipping, to prevent the absorption of moisture—with the addition, perhaps, of an increased length of exposure to the action of the acid.

That some such variation of the ordinary procedure was carried out seems evident from the different proportions of soluble and insoluble gun-cotton in the specimens of Schultze powder supplied by Messrs Blissett and Messrs Bland; for it was found that on the washed wood fibre from each being submitted to the action of a mixture of alcohol and ether, about one half of the former powder and two thirds of the latter were dissolved out. This shows that while the 'Blissett' specimen contained about one half its weight of insoluble or explosive nitro-cellulose, the 'Bland' contained only about one third—a difference which confirms the result obtained by analysis as stated below.

The *soluble* gun-cotton, ordinarily non-explosive, may, however, be rendered explosive by saturating it with bodies rich in oxygen, which promote the decomposition and complete the combustion of the fibre. Nitre is used for that purpose, because it parts with its oxygen readily; and nitrate of baryta is also used, because, being more stable than the nitre, it renders the combustion more gradual than would be the case if nitre were alone employed. When both are used, the nitre, I should think, would start, and the nitrate of baryta continue and finish the combustion of the powder. The amount used is, I suppose, the result of calculation and experiment; but a powder containing little true tri-nitro-cellulose should require more of these salts than one containing much tri-nitro-cellulose; and an excess of the salts would lower the rate of burning of the powder.

I will now give my analysis in full of the three powders, viz.—(1) the ordinary powder issued last season, being part of a supply obtained from

		1877. Bland's.	Blissett's.	1878. Trial or New
	Moisture, per cent.	2·18	2·39	2·97
Extracted by water.	Nitrate of baryta, per cent.	21·50	16·59	22·32
	„ potash, per cent.	11·46	10·46	6·47
	Yellow coloured organic substance, trace of chlorides, &c., undetermined	—	—	—
Insoluble in water.	The converted wood fibre (nitro-cellulose) then remaining contained the following percentage of mineral matter	5·0	6·0	2·95

Messrs Bland, gunmakers, of the Strand; (2) some powder furnished by Messrs Blissett, of Holborn, and alluded to in their letter in the 'Field' of Jan. 19th last, as having damaged a gun made by them; and (3) some of the new powder of 1878, as used at the 'Field' trial of explosives in May last.

The converted wood fibre (after allowing for extraneous mineral matter) possessed the following percentage composition. I place for comparison Professor Abel's determination of the composition of tri-nitro-cellulose, and two of the impurities found along with it, in a parallel column.

	Bland's.	Blissett's.	Trial or New.	Tri-nitro-cellulose.	Impurities.	
Carbon	28·75	28·07	28·12	24·24	29·20	30·50
Hydrogen	3·49	3·65	3·54	2·36	—	2·91
Nitrogen	10·80	15·60	11·66	14·14	11·85	—
Oxygen	56·06	52·68	56·68	59·26	—	—

These powders exploded at a temperature of about 190° C. (347° F.), the different samples varying but slightly. Pure gun-cotton is stated by Professor Abel to explode at 150° C. (302° F.); and black powders are said, by different authorities, to explode at various temperatures between 500° and 600° F., according to the variation in their composition and manufacture.

In addition to the difference in chemical composition of these Schultze powders, I would point out that there is a difference in density—the Blissett being heaviest, the Bland next, and the New the lightest of the three. I think this fact also has some bearing on the violence of the explosion. In black powders, I believe, a dense powder, speaking generally, is stronger than a lighter one; and the Schultze patent states that hard woods make more explosive powders—not, I take it, because the composition is thereby altered, but because a denser powder is produced. It would appear to me, from the above analyses, that the new trial powder should contain rather more explosive force than the Bland variety, though considerably less than the Blissett. The result may, however, be modified by the difference in density of the powders; and your practical experiments will show how far this agrees with the results of the shooting.

I have hitherto only spoken of the explosive force of the powder; now I will touch on another point—its tendency to spontaneous decomposition. Knowing that, in the case of gun-cotton, its stability is injured by a small proportion of resin and other organic impurities, and by the presence of free mineral acids, I did not expect to find this powder (made from a less pure kind of cellulose, from which also it must be somewhat difficult to wash all traces of acid) equal in stability to gun-cotton; and on subjecting the three kinds of Schultze powder to the Government 'heat test' of 150° F. (with a minimum of 10 minutes' duration) it was found that the

New or Trial (1878) powder stood the test 12 m.
'Bland's' sample „ 8 „
'Blissett's' sample „ 7 „

This shows that the 'new' powder is very stable, as it stood the test for 2 minutes beyond the Government minimum, while the other 2 samples were a good way below it. The officials at Waltham Abbey would accept no gun-cotton which did not stand the test for 10 minutes; and I have seen the best gun-cotton stand it for 15.

Whether the loose granulated condition of the Schultze powder, when stored, is sufficient to neutralise this inferiority in purity, and render a sample of Schultze, which only stands the test of 7 minutes, as little liable to spontaneous combustion as gun-cotton which stands the test for 10 minutes, there is at present no evidence to show.

To carry out this 'heat test' properly some practice is required; so, in order to put the matter beyond doubt, I called in the assistance of my friend Mr Arthur Linnell, F.C.S., chemist to the Gun-cotton Company, Stowmarket, a gentleman who uses the test daily, and who carried out the above 3 experiments strictly after the manner adopted by himself and by the Government officials.

In addition to Mr Linnell's experiments, I noted that the aqueous extract of 'Blissett' was very faintly acid; that when heated in a chest at 195° F. moist blue litmus was very quickly reddened.

I think this serious defect (want of stability) is due to want of care in the washing; and I base this opinion on the following facts:

1. The 'Bland' and 'Blissett' samples (the powders of least stability) are of a deeper tint than the 'new' (due to the soluble yellow impurity before mentioned). By continued washing in warm water they become pale, like the more carefully prepared new powder, and the yellow substance is dissolved away. Hence the lighter colour of the 'new' (and most stable) indicates it has less of this organic impurity.

2. Sulphuric and nitric acids are used in the dipping of the powder, but should be entirely washed out, as they promote spontaneous decomposition. If left in, the sulphuric acid will, when the salts are added, decompose the nitrate of baryta, forming insoluble baric sulphate and free nitric acid.

On experiment I ascertained that the abnormally large quantity of mineral matter or ash (5% and 6%) found in the insoluble part of the 'Bland' and 'Blissett' powders *is* due to baric sulphate, and I think the acidity of the aqueous extract is due to the nitric acid thus set free.

Had this baric sulphate been present in the new powder, I should have thought it was purposely formed in all to prevent access of moisture; but, not finding this substance in this carefully prepared sample, I attribute its presence in the other cases to carelessness on the part of the workmen.

I should state that all these powders consisted of a granulated and consolidated pulp. This improvement must, I think, have considerable advantages over the sawdust form previously adopted

by the Schultze Company, inasmuch as it facilitates a more thorough purification being carried out, and produces a more homogeneous and equal powder. It is possible, too, that working with pulp may be of advantage, inasmuch as the company may now, by varying the pressure in forming the cake, obtain grains of any required density.

In conclusion I may say that, in my opinion, the most difficult task which the Schultze Company have had to encounter is that of obtaining uniformity of strength in their explosive; and the 'Blissett' sample of their powder may be looked upon as an experimental batch in which (by altering the mode of procedure in some such manner as I have indicated) they made a powder with a large percentage of tri-nitro-cellulose, thus producing a more rapidly burning substance, and consequently a more violent explosion.

Taking all things into consideration, I think the Schultze Company, in manufacturing a nitro-explosive which gives the uniformity of shooting power shown in your recent experiments, have worked out a most troublesome problem with remarkable success. The difficulty of obtaining such results is evidenced by the fact that so many inventions of a somewhat similar character have been abandoned for sporting purposes from a deficiency in this respect.

But however difficult it may be to manufacture a powder giving uniform shooting, it is evidently possible, with suitable care, to produce (as the 'new' Schultze shows) a wood powder which is perfectly safe and stable, as far as spontaneous decomposition is concerned. The company, therefore, if they have not already done so, ought to take means to prevent powder of the low stability of the 'Bland' and 'Blissett' samples being again issued from their works.

P.S.—Since writing the above I have examined cursorily a sample of the 'Dittmar' wood powder, an American variety of 'Schultze,' used by Captain Bogardus in some of his recent shooting competitions. The powder is somewhat darker in tint, and of slightly larger grain, than the Schultze. In density it is intermediate between 'Bland's' and the 'new' powder; and the charge in a 20-bore cartridge was 42 gr. This powder would seem to be made from solid cubes of wood (not a pulped mass like the present 'granulated' Schultze, or of sawdust splinters like the old so-called 'cube' Schultze). It contains no nitrate of baryta, but has a small quantity of nitrate of potash and soda. Possessing, as it would seem, therefore, a much smaller proportion of oxidising salts than the English Schultze, it should contain, to make up for this loss of force, a larger proportion of explosive pyroxylin; but this is a point I have not experimentally determined ('Field,' August 3rd, 1878, No. 1336, p. 143).

Gunpowder, White. *Syn.* BLASTING POWDER. *Prep.* 1. See BLASTING POWDER, No. 3.

2. Yellow prussiate of potash and white sugar, of each, 1 part; chlorate of potassa, 2 parts; powder each separately, and mix them well, but carefully, with a bone or wooden knife. It may be granulated like gunpowder by making the powder into a paste with a little water, and pressing the mass through a parchment sieve (see the precautions noticed under BLASTING POWDER).

GUT. *Syn.* FISHING GUT, SILKWORM G. This is obtained from the *Bombyx mori*, Linn., or silkworm caterpillar.—*Prep.* The silkworms, when just ready to spin, are steeped in strong vinegar for 12 hours in warm weather, or 2 or 3 in cold weather, and are then broken in half, and stretched out as far as possible on a board, furnished with slits or pegs to hold them; in this state they are allowed to dry in the sun or a warm place.

Obs. Used by anglers. The worms may be known to be going to spin by refusing food, and by having a fine silken thread hanging from the mouth.

GUT'TA PERCHA. The concrete juice of the *Isonandro gutta*, a tree growing only in the Malayan Archipelago, and of other species of the same genus. The stem of the gutta-percha tree grows to the diameter of 5 or 6 feet, and on being notched yields a milky juice, which, after exposure to the air for some time, solidifies, forming the gutta percha of commerce. It arrives in this country in irregular blocks of some pounds in weight, usually containing a large portion of impurities in the form of pieces of wood, stones, and earth. To prepare this crude product for manufacturing into useful articles the blocks are first cut into slices, and then torn into shreds. These are softened by hot water, and kneaded in a 'masticator,' the stones, earth, and other impurities being gradually washed away by water. After several hours the gutta percha is found to be kneaded into a perfectly homogeneous mass, which is rolled or drawn into sheets, bands, or tubes, as required.

Prop., &c. Gutta percha is a tough, inelastic substance, becoming soft and plastic at 212° F., at which temperature two pieces may be firmly welded together. It is one of the best insulators of electricity, is impervious to moisture, and resists the action of acids and alkalies to a great extent. Its best solvents are benzol, chloroform, bisulphide of carbon, rectified mineral naphtha, and rectified oil of turpentine. All these dissolve it readily. According to the analysis of Payen, the purified gutta percha of commerce consists of 75% to 82% of chemically pure gutta percha, which is insoluble in ether and alcohol, and a white and a yellow resin, soluble in boiling alcohol.

Uses. These are numerous and varied. No substance, perhaps, with the exception of caoutchouc, has been 'tortured' to so many different purposes. Its perfect plasticity when warm, and its capability of receiving the most delicate impressions, render it invaluable in many cases where india rubber would be useless. Beautiful mouldings, picture-frames, and a number of ornamental articles, are made from it. To the chemist and photographer it is of great use as a material for making bottles, carboys, photographic baths, and voltaic battery cells. One of the most important uses to which it has been applied is for enclosing the metallic wires used for telegraphic purposes. Its indestructibility by water, its plasticity, and high insulating power, have rendered it particularly valuable for this purpose. At the International Exhibition of 1862 the Gutta Percha Company exhibited one mile

of covered wire perfectly insulated, which was hardly thicker than common sewing cotton. Gutta percha may be rolled into thin transparent sheets, which, being perfectly impervious to moisture, are well adapted for surgical purposes. Again, a solution of gutta percha in chloroform forms an excellent dressing for incised wounds, and a protection for abraded surfaces, burns, &c. It is used in the same way as collodion.

Gutta Percha, Purified. Dr Cattell, of London, has succeeded in purifying gutta percha so perfectly from all extraneous matter that it presents the appearance of ivory. The raw material is dissolved in a certain solvent, and the solution most carefully filtered until it leaves on evaporation the gutta percha in a pure milk-white condition.

GYPSUM. A hydrated sulphate of calcium according to the formula $CaSO_4.2H_2O$.

Occurrence. It is found alone or with anhydrite, $CaSO_4$, chiefly in strata of the Tertiary formation. The following kinds are distinguished:—1. Gypsum spar, foliated gypsum, glass-stone, isinglass stone, or selenite, possessing a very perfect cleavage, and allowing fine laminæ to be separated. 2. Fibrous gypsum, or satin spar. 3. Froth stone, a scaly crystalline gypsum. 4. Granular gypsum, or alabaster. 5. Gypsum stone, or heavy stone, a laminated gypsum. 6. Earthy gypsum, or plaster earth.

The Burning of Gypsum. By this process the water is expelled. The least commercial article is obtained from the heavier and denser varieties of gypsum. The temperature employed should be about 115° C., and should never be lower than 80° C. The gypsum should be first reduced to powder or small pieces. In large quantities gypsum is burnt in an oven or kiln, in small quantities an iron vessel over a coal fire may be used. After the burning the gypsum is ground in a stamp or roller mill, and then sifted.

Prop. Gypsum is soluble in 445 parts of water at 14° C., and in 420 parts at 20·5° C.; the solubility is increased by the addition of sal-ammoniac. When heated in the air, gypsum begins to lose its water at 100° C., and the loss is not complete till the temperature reaches 132° C. If gypsum is 'over-burnt,' that is, heated above 204° C., it loses the property of hardening with water.

Uses. Gypsum is used for architectural purposes; in the manufacture of vases, cheap jewellery, &c.; as a manure; for making casts of objects; &c.

Gypsum Casts. A thin pulp of 1 part gypsum and $2\frac{1}{2}$ parts water is made; this should harden in one or two minutes on standing. Models are made in this substance for metallic castings, for ground works in porcelain manufacture, and for galvano-plastic purposes.

GYROSCOPE. A scientific instrument, consisting of a sort of top with both ends of its axis supported. When revolving rapidly, while freely supported (in gimbals, like the box of a compass), the direction of the axis will remain unaltered as long as the rotation lasts. This curious property of the gyroscope has been made use of to show that the earth rotates about its axis; the axis of the instrument is made to point to a fixed star selected, and it will continue to point in the same direction notwithstanding the rotation of the earth.

HAD'DOCK. A small sea-fish, allied to the cod, and esteemed an excellent article of food. It is the *Gadus æglefinus* of Linnæus. Split, smoked, and dried, it is consumed in large quantities in England.

HÆMATEM'ESIS. In *pathology*, vomiting of blood. See STOMACH AFFECTIONS.

HÆMATITE. *Syn.* HEMATITE. In *mineralogy*, one of the most important iron ores. There are two kinds, the red and the brown; the red variety, which is anhydrous, is found in the older geological formations, sometimes embedded in gneiss and granite. It is sometimes called 'bloodstone,' because, when scratched with a file or knife, it exhibits a deep red-coloured streak; and sometimes 'glassy head,' owing to its external lustre. When this ore is mixed with lime it is called 'minette;' it is sometimes mixed with silica or alumina. The brown variety of hæmatite occurs in several forms under the general name of göthite; it is hydrated, its composition being represented by the formula $Fe_2O_3.H_2O$.

HÆMATOX'YLIN. A principle obtained by Chevreul from common logwood (*Hæmatoxylon campechianum*), and on which its colour appears to depend. The unfermented chips should be used in its preparation.

Prep. 1. Infuse logwood chips in water, at a temperature of about 130° F., for 12 hours, filter, and evaporate to dryness in a water-bath; digest the residuum in rectified spirit for 24 hours, again filter and evaporate; then add a little water; again gently evaporate, and set aside the solution in a cold place that crystals may form; these must be washed in rectified spirit and dried.

2. Digest powdered hard extract of logwood in rectified spirit, and proceed as last.

3. Powdered logwood is mixed with sand and digested for several days in pure ether; the resulting liquid is filtered, evaporated to a syrup, and set aside to crystallise.

Prop., &c. Brilliant reddish-white or straw-yellow crystals, soluble in boiling water, forming an orange-red solution which turns yellow as it cools, but resumes its former colour on being heated. Alkalies in excess change its colour successively into purple, violet, and brown; acids brighten it; with the metallic oxides it forms compounds having a blue, purple, or violet colour. It is much used for staining histological specimens.

HÆMOP'TYSIS. In *pathology*, spitting of blood. It generally arises from extreme fulness of the blood-vessels of the lungs, or the rupture of blood-vessels as a consequence of ulceration; but sometimes it is induced by excessive exertion or external violence. The treatment depends upon the cause, and will vary considerably. The sucking of small pieces of ice is often of great service, but in all cases medical advice should be sought.

HÆM'ORRHAGE. *Syn.* HEMORRHAGE. See BLEEDING.

HAIR. *Syn.* CAPILLUS, PILUS, L. Of all

organic substances, hair is the one least liable to suffer spontaneous change. It is also less affected by liquids than most other substances. Hence its value in various branches of the useful arts.

The preservation of the hair of the head, independently of its connection with personal beauty, is a matter of the utmost importance in relation to hygiene. In other parts of this work we have referred to its management under various conditions, but a few observations may be added here.

When the hair is in a weakly state, and either falls off or grows feebly, frequently cutting it will be found of the greatest service. "In the arrangement of the hairs on the surface of the body it might be inferred that little existed to excite attention; but this is not the fact if we are to judge by the careful investigations to which the subject has given rise. The hair-tubes are not placed perpendicularly, but obliquely, in the skin; hence the direction of the hairs, after their escape from the tubes, is in the same sense inclined towards the surface; and the 'set' of the hair, from the root to the point, is governed by a law as precise as that which regulates any other of the secondary vital functions. Thus, on the head, the hair radiates from a single point, the crown, to every part of the circumference, making a gentle sweep, behind towards the left and in front to the right. The direction of this sweep is naturally indicated on the heads of children, and is that in which the hair is turned" (*Eras. Wilson*). The same occurs on the face and other parts of the body. In making our toilet this natural arrangement of the hair should be interfered with as little as possible. Combing it, or banding it in an opposite direction to that which it naturally assumes, is highly prejudicial to its healthy growth, and if long persevered in, leads to its premature and rapid decay. The practice now common among ladies, of throwing the hair from the forehead towards the back of the head, is of this reprehensible character.

In addition to our remarks elsewhere, we may here observe that all the various systems proposed for strengthening or restoring the hair depend for their efficacy upon simple excitation or stimulation of the skin. Friction with the hair-brush, and the use of the ordinary hair oils, pommades, and washes, are of this kind. The various advertised nostrums for reproducing or restoring the hair are either stimulants or rubefacients of more or less activity, or are emollients, which are directed to be applied by friction in such a manner as to set up a considerable amount of irritation. When the affection depends on the languid circulation of blood in the part this treatment often succeeds; but when the hair-bulbs are withered or decayed, or the scalp much attenuated, the restoration of the hair is an impossibility. See BALDNESS.

HAIR COSMETICS. Under this head are included all preparations which are used for beautifying, preserving, or restoring the hair. These are fully described in different parts of this work, and we shall here merely name the principal heads under which they will be found. The hard pomatums used for keeping the hair, moustache, and whiskers in form, and sometimes to colour them at the same time, are noticed under COSMETIQUE; the mucilaginous preparations for stiffening the hair, under FIXATURE; the compounds for removing superfluous hairs, under DEPILATORY; the applications for the cure and prevention of baldness, under POMMADES and WASHES; and those employed to cleanse or beautify the hair under the last two heads, and under HAIR DYES and OILS.

HAIR DYES. *Syn.* TINCTURA CAPILLORUM, L. The practice of dyeing the hair is of great antiquity; and though not so common as formerly, it is still far from infrequent at the present day. The numerous preparations vended for this purpose have generally a basis of lead or silver. Bismuth, pyrogallic acid, and certain astringent vegetable juices are also occasionally thus employed. The following list embraces all those of any value:

Prep. 1. Litharge, 1 part; fresh-slaked lime and starch, of each, 2 parts; all in fine powder, and perfectly dry; mix, and keep the compound in well-corked bottles. This powder is to be made into a thin paste or cream with water (for black) or milk (for brown), and applied to the hair (previously freed from grease with soap and water, and dried), by means of a sponge or brush, or the fingers; observing to rub it well into the roots, and to pass a comb for some time through it, to ensure its coming in contact with every part. The whole must be then covered with a moist leaf of cotton wadding, or some brown paper several times doubled and well damped with hot water, and allowed to remain so for 3 or 4 hours, or even longer; or an oil-silk cap, or a bladder, may be worn, the object being simply to prevent the evaporation of the moisture. After a sufficient time has elapsed the powder may be removed by rubbing it off with the fingers, and afterwards washing it out with warm soap and water. A little pomatum or hair oil will restore the usual gloss to the hair. Another method of operating is to apply the cream or paste as before, and then to keep rubbing it about the hair with a brush as long as may be required, occasionally adding a few drops of hot water to preserve the whole moist. In this way the action of the dye is facilitated, and the process concluded in a much shorter time.

2. Lime (slaked in the air), 2 parts; carbonate of lead (pure white-lead), 1 part; mixed and applied as the last.

3. (AQUA ORIENTALIS.) From grain silver, 2 dr.; steel filings, 4 dr.; nitric acid, 1 oz.; soft water, 1½ fl. oz.; digested together, the solution being afterwards diluted with water, 3½ fl. oz., and filtered. Applied by means of a fine-toothed comb, or a half-worn tooth-brush, to the hair, previously well cleaned with soap and water and dried.

4. (ARGENTAN TINCTURE.) From nitrate of silver, 1 dr.; eau de rose, 1 fl. oz.; nitrate of copper, 2 gr., or q. s. to impart a slight greenish tint. Used as the last.

5. (*Dr Cattell.*) Nitrate of silver, 11 dr.; nitric acid, 1 dr.; distilled water, 1 pint; sap green, 3 dr.; gum-arabic, 1¼ dr.; digest together. Used as No. 3.

6. No. 1 Solution. Gallic acid, 7½ gr.; acetic acid, 20 min.; distilled water, 1 fl. oz.

No. 2 Solution. Nitrate of silver, in crystals, 30½ gr.; distilled water, 1 fl. oz.; ammonia, sufficient to dissolve the precipitate formed at first.

7. (CHESTNUT HAIR DYE.) "We have met with the following, but do not guarantee it:—Permanganate of potash gives the hair a beautiful chestnut-brown colour, varying according to the strength of the solution of the salt. A good formula is permanganate of potash, 1 dr.; powdered gum-arabic, 2 dr.; rose-water, 3 oz.; mix. Apply carefully with a tooth-brush, so as to avoid staining the skin ('Chemist and Druggist').

8. (HAIR RESTORER.) This is in reality a dye. Sulphur, 45 gr.; acetate of lead, 20 gr.; glycerin, ½ oz.; water to make up 10 oz.

9. (GOLDEN HAIR DYE, AUREOLINE.) A solution of peroxide of hydrogen in water, containing from 3% to 6% of the peroxide.

10. (BROWN HAIR DYE.) Acetate of lead, 2 dr.; hyposulphite of soda, 1 dr.; rose-water, 14 oz.; glycerin, 2 oz. Dissolve the acetate of lead and the hyposulphite in separate portions of the rose-water; filter separately, mix the solutions, and add the glycerin.

11. (A HARMLESS HAIR DYE. *Dr Hager.*) Ten parts of subnitrate of bismuth and 150 parts of glycerin are mixed in a glass vessel and heated in a water-bath; solution of potash is then added in small portions, and with continued agitation, until a clear solution has been obtained, to which a concentrated solution of citric acid is added until merely a slight alkaline reaction is observed. Enough orange-flower water is added to make the whole liquid weigh 300 parts; the addition of a small quantity of a solution of an aniline colour completes the preparation.

12. (BROWN HAIR DYE.) Pyrogallic acid, ½ oz.; sodium sulphate, ½ dr.; rectified spirit, 1 oz.; water, 3 oz. Dissolve the acid in the spirit and the sulphate in the water. Mix the solutions.

13. (*Teinte Delcroix.*) From acetate of lead, 2 oz.; prepared chalk, 3 oz.; quicklime, 4 oz.; each in an impalpable powder. Used as No. 1.

14. (EAU D'AFRIQUE. *Hopekirk.*) *a.* Nitrate of silver (cryst.), 1½ dr.; distilled water, 2 fl. oz.; dissolve, and pour the solution into the bottles labelled 'Solution No. 1.'—*b.* Liquor potassæ, 3 dr.; sulphydrate of ammonium, 7 dr.; water, 1 fl. oz.; mix, and pour the liquid into the bottles labelled 'Solution No. 2.' For use, the hair is moistened by means of a small-toothed comb or tooth-brush with the Solution No. 1, either alone or diluted with a little water, care being taken to avoid touching the skin if possible. After the lapse of 8 or 10 minutes the Solution No. 2, diluted with at least 5 times its measure of water, is applied in the same manner, and any spots on the skin removed by rubbing them with the corner of a napkin wetted with the liquid. The skin is then sponged clean with a little warm water and wiped dry, and the hair is arranged with the comb as usual. It is better to avoid rubbing it or washing it for a few hours. Sometimes the process is reversed, and the liquid No. 2 applied first. In this way the stains on the skin are more readily removed, but the dye is less permanent than when the other plan is adopted.

15. (EAU D'ÉGYPTE.) Resembles No. 4 (*above*).

16. (ESSENCE OF TYRE.) Resembles the last.

17. (GRECIAN WATER.) Resembles No. 3 or 4.

18. (*Dr Hanmann.*) Litharge, 275 gr. (say 1 part); quicklime, 1875 gr. (or 6⅞ parts); hair powder (or starch), 930 gr. (or 3½ parts): all in fine powder. Used as No. 1.

19. (*Hewlet's.*) Resembles Spencer's (No. 28).

20. (INSTANTANEOUS.) Moisten the hair first with a solution of nitrate of silver in water (1 to 7 or 8), and then with a weak solution of sulphydrate of ammonium. The colour of the hair, unaltered by the silver solution, instantly turns black when moistened with the sulphydrate. See EAU D'AFRIQUE.

21. (*La Forest's.*) See WASHES.

22. (*Orfila's.*) From litharge, 3 parts; quicklime, 2 parts; starch, 1 part. The original formula for this article is as follows:—Sulphate of lead, 4 parts; dry fresh-slaked lime, 5 parts; water, 30 parts; boil 1 hour, collect the paste on a piece of calico, and apply it in a similar manner to No. 1.

23. (POMMADE DYE.) *a.* Nitrate of silver, 1 part; nitric acid, 2 parts; iron filings, 2 parts; mix, and let them stand together for 4 or 5 hours, then pour them on oatmeal, 2 parts; next add lard, 3 parts, and mix well together.

b. From nitrate of silver and cream of tartar, of each, 1 dr.; liquor of ammonia, 2 dr.; dissolve; add of lard, 4 dr., and mix well together.

24. (POUDRE D'ITALIE.) Resembles Orfila's (No. 22).

25. (PYROGALLIC STAIN.) A weak solution of crude pyrogallic acid. Another article sold under this name is prepared by distilling nut-galls (coarsely powdered) in a retort, dissolving the solid acid which sublimes in a little hot water, and after mixing this with the acid liquid which also passes over, adding a little rectified spirit. The floating oil is then separated and the solution filtered.

26. (*Redwood.*) Litharge, 2 oz.; slaked lime and powdered starch, of each, 1 oz.; liquor of potassa, 2 dr.; water, q. s. to form a thick cream. Used as No. 1.

27. (*Redwood.*) Liquor of potassa and distilled water, of each, 1 pint; mix, and pass sulphuretted hydrogen through the liquid until it is saturated. Of this solution take 20 oz.; liquor of potassa, 4 oz.; mix, and label it 'Solution No. 1.' Next dissolve nitrate of silver, 1 dr., in distilled water, 2 oz.; and label the liquid 'Solution No. 2.' Used in the same manner as Nos. 8 and 20.

28. (*Spencer's.*) From sap green, ½ dr.; nitrate of silver, 1 dr.; hot water, 1 oz. Applied as No. 3.

29. (TINCTURE OF WALNUT.) A strong tincture of the shells of green walnuts, scented with oil of lavender.

30. (*Ure.*) Litharge, fresh-slaked lime, and bicarbonate of potassa, mixed in various proportions, according to the shade of colour desired. Used like No. 1.

31. (*Warren's.*) From litharge, 1 oz.; white-lead, 2 oz.; quicklime (in fine powder), 16 oz.; mix, sift through lawn, and at once bottle the mixture. Used like No. 1. Mixed with water, it is said to dye the hair black; with milk, brown.

32. White-lead, 1 oz.; fresh-slaked lime, 1½ oz.; litharge and oxide of bismuth, of each, ½ oz.;

water, 1 pint; mix, boil 15 minutes with frequent agitation, cool, pour it into a bottle, add of solution of ammonia, ¼ fl. oz., shake the whole frequently for some hours, and the next day pour off the liquid portion from the white sediment which forms the dye. Used like No. 1. It is applied for 8 or 10 minutes for a brown; 30 minutes, or longer, for a black. For the first, it is washed off with water containing a little common soda.

33. The juice of the bark or shell of green walnuts, applied with a sponge (*Paulus Ægineta*).

34. A leaden comb used daily is said to darken the hair, but we have known persons persevere in its use for months without any perceptible change occurring. Premature baldness is a frequent consequence of its use.

35. (*Martindale.*) Tartaric acid, 75 gr.; water, 100 minims; nitrate of bismuth (crystallised), 230 gr.; dissolve in 1 pint of water. Filter off and wash the precipitate, dissolve it in 2 dr. of strong solution of ammonia; add glycerine, 20 minims, and hyposulphite of sodium, 75 gr.; dissolve, and add water to 4 oz. It is quite harmless, and changes the colour of white hair to a deep chestnut.

Obs. It is right to inform the reader that all those compounds which contain nitrate of silver stain the skin as well as the hair. These stains may be removed, when quite recent, by rubbing them with water containing a little sulphydrate of ammonium (see *above*) or iodide of potassium in solution; but as this is attended with some trouble and inconvenience, the best way is to avoid the necessity of doing so. The hairdressers adopt the plan of smearing hard pomatum over the skin immediately surrounding the hair, to protect it from the dye. By very skilful manipulation and the observance of due precautions the hair may be thoroughly moistened with the above fluids without touching the adjacent skin; but this can only be done, in the case of the hair of the head, by a second person. This has led to a preference being given by many to the compounds containing lead, as the colouring matter formed in them does not stain the skin. The hue given by the latter (when pale) is very apt to possess an unnatural redness, but all the shades of colour given by the preparation of silver are rich and unexceptionable. Pyrogallic acid and the juice of walnuts also stain the skin, although less intensely and permanently than nitrate of silver.

The detection of dyed hair is often a matter of importance in medico-legal research. The presence of silver may be shown by digesting the hair in a little weak chlorine water or hydrochloric acid, when the resulting chloride of silver may be dissolved out with liquor ammoniæ, and submitted to the usual tests. Hair containing lead, when digested in dilute nitric acid, gives a solution of nitrate of lead, in which form it is readily detected. See LEAD and SILVER.

All the preceding compounds are for dyeing living hair (human); horsehair, bristles, &c., and other dead hair may be readily stained by steeping them in any of the ordinary liquid dyes, more especially those employed for wool and silk. See POMMADES, WASHES, &c.

HAIR WASH, Golden, or Auricomus, is a clear inodorous fluid, which is said to dye hair blond or yellowish red, and really does so. Sold in bottles containing 250 grms. When exposed to the air the fluid decomposes with time. This hair dye is an aqueous solution of hydroxyl contaminated with traces of baryta, and can be prepared as follows:—17 parts crystallised caustic baryta and 3 parts potassium chlorate, intimately mixed in fine powder, are melted by a gentle heat. The mass must be washed with cold water to remove the potassium chloride, and the residue shaken in the cold with a solution of 8 parts glacial phosphoric acid in 25 parts water, the whole being cooled with ice. When the peroxide of barium is decomposed, the fluid should be decanted from the precipitate (*Hager*).

Hair Wash, Quinine. Quinine sulphate, 20 gr.; glycerine, 1 oz.; cologne, 2 oz.; bay rum, 2 oz.; rose-water, 11 oz. Rub the quinine with the glycerine, and add the other ingredients in order named. The addition of fluid extract of jaborandi is recommended to stimulate the growth.

Hair Wash, Rosemary. This does not make the hair grow, but it is a cooling and cleansing preparation:—Acetic acid, B. P., 4 dr.; vinegar of cantharides, 1 dr.; spirit of rosemary, 1 oz.; essence of white rose, 1 dr.; water, to 8 oz.; mix.

HALL MARKS. The 'Hall Marks' on articles in gold and silver not only inform us of their fineness, but furnish us with other important particulars.

The Hall Mark (proper) denotes the place of manufacture or assay, being an anchor for Birmingham; a dagger or 3 wheat-sheaves for Chester; Hibernia for Dublin; castle and lion for Edinburgh; castle with 2 wings for Exeter; tree and salmon with a ring in its mouth for Glasgow; leopard's head for London; 3 castles for Newcastle-on-Tyne; a crown for Sheffield; and five lions' heads and a cross for York.

The Duty Mark is the head of the Sovereign, showing that the duty is paid.

The Date Mark is a letter of the alphabet, which varies every year, and with the different companies, thus: the Goldsmiths' Company of London have used from 1716 to 1755, roman capital letters; from 1756 to 1775, small roman letters; from 1776 to 1795, old English letters; from 1796 to 1815, roman capital letters, from A to U, omitting J; from 1816 to 1835, small Roman letters, a to u, omitting j; from 1836, old English letters.

The Standard Mark for gold is, for England, a lion passant; Edinburgh, a thistle; Glasgow, a lion rampant; Ireland, a harp crowned. For silver, a figure of Britannia. If under 22 carats, gold has the figures 18.

The Manufacturer's Mark is the initials of the maker, as S. H., W. T., C. E., &c.

HAL'OGENS. In *chemistry*, a name, signifying salt-producers, given by Berzelius to chlorine, bromine, iodine, and fluorine. These elements unite with metals to form compounds called 'haloid salts,' as sodium chloride or common salt, potassium iodide, &c. See CHLORINE, BROMINE, IODINE, and FLUORINE.

HALTICA CONCINNA. The Hop Flea (or Beetle). This insect to ordinary observers closely resembles the turnip flea proper, *Haltica*

nemorum. Under the microscope it will be seen that it differs considerably. Its colour is brassy, whereas the colour of its congener is dusky or black, and its wing-cases are striped. They both have wonderful powers of jumping. The former has a curious toothed formation of the tibia, or shank, with a set of spines, while the tibia of the turnip flea is without any curve. Curtis speaks of the *Haltica concinna* as infesting hop plantations. Taschenberg also alludes to its eating the leaves of hop plants in Germany. Harris gives an account of several species of *Haltica* in America as destructive to crops, but he does not mention this particular species.

In some seasons, more especially when the hop plants are backward and are kept back by cold unkindly weather, these fleas or beetles do infinite harm to them by eating the leaves and making many holes in them with strong jaws furnished with double sets of teeth, and made purposely for biting out and masticating leaf tissue. They also much injure the leaves, and thereby weaken the plants by the larvæ burrowing in the parenchyma or cellular tissue of the leaves. They follow the bines as they grow, but it rarely happens that they are able to do much harm after the plants have really made a good start in favourable climatic conditions.

Life History. The flea, in reality a winged beetle, passes the winter in the perfect state under clods, tufts of grasses, or weeds near the hop plants, or on the outsides of hop plantations. In early spring, directly the bines are ready to tie, they come up from the ground near the plant-centres, or fly from their retreats at a distance, and at once begin to eat and fret the leaves. Pairing takes place and eggs are laid under the leaves as well as on the smaller bines. Only one egg is laid daily by a female, so that these insects are not very prolific. In about eight or nine days larvæ, little white maggots, with six pectoral feet, are hatched from the eggs, and immediately burrow in the leaves and feed upon their tissues. In about a week they become chrysalids, and in due time the perfect beetles appear again, and the life stages are repeated. Breeding goes on thus in favourable circumstances until September. It is alleged that the flea deposits eggs within the hop cones, and that the larvæ mining the strigs, or stems, cause the decay and disintegration of the bracts. This has not been quite determined, but it seems very probable that the serious damage to hop cones, which has increased so much within the last ten years, may be caused by fleas, together with another insect which is described further on.

Prevention. As the fleas rejoice in cloddy ground, or are at least always more plentiful when the soil is rough and unkindly, it is desirable to work well round the plant-centres early, and get a good season all over the plantation as quickly as possible after poling. Weeds should be banished, both in the plantations and round the outsides. Pieces of old bine should be carefully collected and carried away when the ground is dug in the late autumn and winter, and when the plants are dressed the bits of bine should be taken away from the ground at once. Thorough cultivation up to picking-time is essential to keep the soil well moved and to prevent weeds, especially near the plant-centres. After a bad attack lime, or soot, or lime ashes, or guano should be put round the plant-centres in October and worked well in.

Remedies. When hop plants are troubled by these fleas it is often very useful to put soot over and round the plants, and after a day or two to prong hoe the soil close to them and pulverise it as much as possible. They jump off the plants when disturbed and take refuge in the clods. In cases where the injury is very great, tarred boards or sacking should be held near the ground under the plants and the poles tapped with a stick, so that the fleas jump into and are retained by the tar ('Report on Insects Injurious to Crops,' by Charles Whitehead, Esq., F.Z.S.).

HAMAMELIS. *Syn.* Witch-hazel. The bark, leaves, and twigs of *Hamamelis virginica*. A tincture of the bark, and a distilled water (hazeline) are employed as astringents, to allay hæmorrhages and mucous discharges. A small quantity of the strong tincture of hamamelis should always be carried on long pedestrian excursions. A few drops on a plug of cotton-wool applied to the part on the first sign of irritation will effectually prevent external piles, one of which the size of a lentil is sufficient to cause most acute misery and discomfort.

HAMBURGH POWDER. The material known under this name is used to adulterate chicory. It is composed of roasted and ground peas, coloured with Venetian red.

HAMS. These are usually prepared from the legs of bacon pigs, but those of the sheep are also sometimes used for the same purpose. Smoked ham is strong eating, and rather fit for a relish than for diet, and should be particularly avoided by the dyspeptic and by convalescents.

Choice. A sharp knife thrust under the bone should have a pleasant smell when withdrawn. The recently cut fat should be hard and white, the lean fine-grained and of a lively red. Those short in the hock are the best.

Curing. An ordinary sized ham requires nearly 3 weeks if wet salted, and about a month if dry salted, to cure it perfectly. At the expiration of this time they are ready for smoking. Mutton hams should not lie in pickle longer than 12 or 14 days.

Cooking. Hams should be put into the water cold, and should be gradually heated. A ham of 14 lbs. will take about 4 hours, one of 16 lbs. will take 6½ hours, and one of 20 lbs. about 5½ hours, to dress it properly. "If it is an old ham, it should be soaked for 12 hours previously" (*Soyer*).

Pres. Most grocers and dealers in hams enclose them, after being smoked, in canvas, for the purpose of defending them from the attacks of the little insect, the *Dermestes lardarius*, which, by laying its eggs in them, soon fills them with its larvæ or maggots. This troublesome and expensive process may be altogether superseded by the use of pyroligneous acid, applied by means of a painter's brush.

HANDS. Dirty and coarse hands are no less the marks of slothfulness and low breeding, than clean and delicate hands are those of cleanliness

and gentility. To promote the softness and whiteness of the skin, mild emollient soaps, or those abounding in oil, should alone be used, by which means CHAPS and CHILBLAINS will generally be avoided. The coarse, strong kinds of soap, or those abounding in alkali, should for a like reason be rejected, as they tend to render the skin rough, dry, and brittle. The immersion of the hands in alkaline lyes, or strongly acidulated water, has a like effect. When the hands are very dirty, a little good soft soap may be used with warm water, which will rapidly remove oily and greasy matter. Fruit and ink stains may be taken out by immersing the hands in water slightly acidulated with vinegar or a few drops of oil of vitriol, or to which a little pearlash or chloride of lime has been added; observing afterwards to well rinse them in clean water, and not to touch them with soap for some hours, as any alkaline matter will bring back the stains, after their apparent removal by all the above substances, except the last. Common sperm oil is most useful for cleaning the hands after some kinds of dirty work, especially soldering, and if well rubbed in will so loosen the dirt that a good wash with coarse soap and water will cleanse them effectually. The use of a little chloride of lime and warm water, or Gowland's lotion, imparts a delicate whiteness to the skin; but the former should be only occasionally used, and should be well washed off with a little clean water to remove its odour. Glycerin employed in the same manner renders the skin soft, white, and supple. The use of a little sand or powdered pumice-stone with the soap will generally remove the roughness of the skin frequently induced by exposure to cold. The hands may be preserved dry, for delicate work, by rubbing a little club moss (LYCOPODIUM), in fine powder, over them. A small quantity of this substance sprinkled over the surface of a basin of water will permit the hand to be plunged to the bottom of the basin without its becoming wet.

HANG'ING. In cases of suspended animation from hanging, the assistance must be prompt and energetic. The body on its discovery should be instantly relieved from the state of suspension and all pressure about the throat. The remedial *treatment* chiefly consists, in the severer cases, in cupping the temples, and so relieving the head of the blood which is accumulated in its superficial veins in consequence of strangulation. When the body is cold, friction, and the other means used for restoring the animal heat in drowned persons, should be resorted to. See ASPHYXIA and DROWNING.

HARD'NESS. Compactness; solidity; the power of resisting abrasion. Mineral substances are frequently distinguished and identified by their relative hardness. This is ascertained by their power to scratch or be scratched by one another. A valuable table on this subject will be found in the article on GEMS. Also a term applied to certain qualities of water. See WATER.

HAR'MALINE. *Syn.* HARMALINA. An alkaloid, forming yellow-brown crystals, discovered in the seeds of *Peganum harmala.* It has a bitter astringent and acrid taste, is soluble in alcohol, and forms yellow soluble salts with the acids. It has been proposed as a yellow dye. By oxidation it yields another compound (harmine), which is a magnificently red dye-stuff, easily prepared and applied. The seeds are produced abundantly in Southern Russia.

HAR'NESS POLISH. See BLACKING, &c.

HARTS'HORN. *Syn.* CORNU CERVI, C. CERVINUM, CORNU (Ph. L.), L. The 'horn of the *Cervus elephas*' (Ph. L.), or stag.

Hartshorn, Burnt. *Syn.* CORNU USTUM (Ph. L.), CORNU CERVI USTUM, L. *Prep.* (Ph. L. 1836.) Burn pieces of harts' horns until perfectly white, then grind and prepare them in the same way as directed for prepared chalk.

Obs. Finely powdered bone-ash is usually sold for burnt hartshorn, and possesses exactly the same properties.—*Dose,* 10 to 30 gr., or more, 2 or 3 times a day, in rickets, &c.

Hartshorn Shavings. *Syn.* HARTSHORN RASPINGS; RASURA CORNU CERVI, RAMENTA C. C., L. Obtained from the turners. Boiled in water, it yields a nutritive jelly. Used by straw-plait workers to stiffen bonnets, &c.

HATCH'ING. See INCUBATION.

HATS. Those should be chosen possessing a short, smooth, fine nap, and a good black colour; and sufficiently elastic to resist ordinary wear and tear, without breaking or giving way. The HAT BRUSH for daily use should be made of soft hairs, but a stiffer one should be employed occasionally, to lay the nap smooth and close. Grease may be removed by means of porous brown paper, and pressure with a hot iron.

HAUSMANNITE. A native oxide of manganese. See MANGANESE.

HAY-FEVER. *Syn.* HAY-ASTHMA; CATARRHUS ÆSTIVUS, L. Dr Aitken defines this affection as "a variety of asthma or catarrh, occurring generally during the summer months, especially during the inflorescence of the hay-crop, or during the drying or conversion of the newly mown grass into hay, in May and June." The disease is distinguished by extreme irritation of the eyes, nose, and the whole of the air-passages, these symptoms giving rise in succession to troublesome itching of the eyes and nose, frequent paroxysms of sneezing, with copious discharge from the nostrils, pricking sensation in the throat, cough, tightness of the chest, and difficulty of breathing, sometimes with and sometimes without great mucous expectoration. The inhalation of the powder of ipecacuanha sets up similar symptoms with some persons.

The pollen grains of the grasses appear to be the cause of the disease. They float in the air in enormous numbers, get into the mucous membrane of the air-passages, absorb moisture, swell and burst, discharging a number of particles which cause great irritation. This supposition as to the origin of this disease derives support from the circumstance that it always takes place during the hay season, and at no other; and also that it may be cured by the avoidance of hay-fields and haystacks. "Hence going to the sea-coast, and especially to those parts of the coast that are barren of grass, offers a means of protection; and when this cannot be done, such persons obtain refuge in some measure from the cause of irritation by remaining within doors and shutting out as much as possible the external air during the hay-crop" (*Sir Thomas Watson*).

Furthermore, those whom the disease attacks are not particularly subject to catarrh at other times.

Treatm. Numerous remedies have been proposed and employed for hay-asthma. Dr Elliotson suggests the mild fumigation of the patient's apartment by means of the solutions of the chlorides of lime or soda; and further advised the sufferers using a smelling-bottle containing one or the other of the chlorides. He also employed with success the sulphate of quinine and iron. Mr Gordon recommends the tincture of *Lobelia inflata*, with the use of the cold shower-bath. Tincture of nux vomica is also said to have been used with good results, as also has Fowler's solution of arsenic, with very decided advantage, by Dr Mackenzie.

These potent remedies, however, should only be administered under the supervision of a qualified medical practitioner. An esteemed medical friend assures us he has employed the new remedy, *Quinetum* (the alkaloid of the East India red bark), with the happiest effects. He gives 4 gr. of the quinetum 3 times a day. The use of an ori-nasal respirator of cotton-wool has also been suggested. Great relief has, we know, in a great number of cases, been experienced by snuffing from a smelling-bottle containing the following ingredients:—Pure crystallised carbolic acid, 1 dr.; sesquicarbonate of ammonia, 1 oz.; wood charcoal, 1 oz.; oil of lavender, ½ dr.; compound tincture of benzoin, ½ oz.; all reduced to fine powder, and thoroughly mixed.

HEAD'ACHE. *Syn.* CEPHALALGIA; DOULEUR DE TÊTE, Fr.; KOPFSCHMERZ, Ger. Headache is too well known to require description, but as it may arise from a very large number of widely different causes it is desirable to classify the different forms, so that a rational line of treatment may be adopted. Headaches may be classed under one of the following heads:

1. STRUCTURAL HEADACHE, or headache resulting from disease within the cranium.
2. CONGESTIVE HEADACHE.
3. NERVOUS or SICK HEADACHE. Hemicrania or megrim.
4. TOXÆMIC HEADACHE.

1. *Structural Headache* may be due to any form of disease of the brain or its membranes, meningitis, softening, or cerebral abscess. In these cases there will be usually other signs to indicate the true cause of the pain, and the gravity of the symptoms will be such as to require medical advice.

2. *Congestive Headache.* Due to the presence of an excess of blood in the vessels of the brain.

Active congestion may be due to hypertrophy of the left side of the heart, irregularities in the menstrual flow, mental and emotional excitement, and other causes.

Passive congestion may arise from defects in the heart, irregular and defective action of the liver, bowels, and skin, drunkenness, anæmia, fatigue, or loss of blood.

3. *Nervous Headache. Syn.* SICK HEADACHE, MEGRIM, HEMICRANIA; MIGRAINE, Fr.; MIGRÄNE, Ger. This form of headache is more or less periodic, *i. e.* it goes and comes at tolerably regular intervals. It generally affects one side of the head only, and is often accompanied by nausea and bilious vomiting; much more common in women than in men, and usually associated with a nervous temperament, want of tone in the system, and anæmia. Migraine is often hereditary.

4. *Toxæmic Headache.* The headache of fever and inflammatory disorders, probably chiefly due to altered conditions of the blood.

Treatm. The treatment of headache must of necessity depend upon the exciting cause, and where this can be removed or modified much can be done. This is especially the case in congestive headaches, where attention to diet and general habits, careful regulation of the bowels, combined with the use of tonics and outdoor exercise, will generally afford great relief. Nervous headache is more obstinate and difficult of cure; overwork and anxiety, feeble nutrition and disorders of menstruation are common causes to be combated by their special remedies. Iron, strychnine, and cod-liver oil are valuable in these cases, and sometimes 10-gr. doses of potassium bromide, 3 times a day with vegetable bitters, have proved useful. Arsenic and quinine are also strongly recommended by some authorities.

It should never be forgotten that some headaches are due to the improper use of defective eyesight, and children who complain of pain in the head after reading should be taken *at once* to see a competent oculist. A proper pair of spectacles will often save much misery.

HEALTH, GOOD, Gut-Heil. (*Aust.*) A liquor containing the extractive matters of calamus root, rhubarb, cinnamon, orange peel, &c., with 35% of sugar (*Hager*).

HEAR'ING. See DEAFNESS, EAR, &c.

HEART'BURN. *Syn.* CARDIALGIA, L. Anxiety and pain about the region of the stomach, generally attended by a sense of gnawing and heat; hence its popular name. Faintness, nausea, and eructation of a thin, acidulous, watery liquid, especially in the morning, are common symptoms of this complaint. The usual causes of heartburn are excess in eating and drinking, the use of improper food, and sedentary habits. A good remedy is a teaspoonful of carbonate of magnesia, or carbonate of soda, in a glass of peppermint or cinnamon water, to which a little powdered ginger may be added with advantage. This dose may be taken 2 or 3 times daily until the disease is removed. Articles of food that easily undergo fermentation should at the same time be avoided, and a dry diet had recourse to as much as possible. Soda water, toast-and-water, and weak spirit-and-water are the most suitable beverages in this complaint.

HEAT. *Syn.* CALORIC; CALORICUM, L. The consideration of this subject belongs to *physics* and *chemistry*. Much useful information, in connection with it, will, however, be found in this work under the heads EBULLITION, EVAPORATION, EXPANSION, REFRIGERATION, &c.

HEAVY SPAR. Native sulphate of barium. See BARYTA.

HED'ERIN. *Syn.* HEDERINA, L. From the decoction of the ground seeds of ivy (*Hedera helix*), boiled in water, along with a little slaked lime or magnesia, the precipitate being afterwards digested in rectified spirit, and the filtered tincture evaporated. Febrifuge and sudorific.

HEIGHT, Average, of Man. The 'Boston Journal of Chemistry' gives the following particulars of the average height of man:—"The Yankee would appear to be the tallest of civilised men, if we may trust some statistics given in foreign journals as the result of the measurement of over half a million men. The mean height of the American Indian is 67·934 inches; of the American white man, 67·672; Scotch, 67·066; English, 66·575; Russian, 66·393; French, 66·277; Mexican, 66·110."

The following Tables show the Height of Englishmen at various ages in inches.

Age.	Average.	According to Class.		
	English Male.	Affluent.	Artisan.	Farm Labourer.
10	51·8	52·9	50·7	50·9
15	62·2	62·9	61·4	61·8
20	67·5	68·3	66·5	66·9
24	67·7	68·4	66·6	67·5
30	67·9	68·5	66·8	67·6
40	68·0	68·7	67·1	67·6
50	67·9	68·1	66·6	67·8
60	67·7	68·1	66·5	68·0
70	67·2	68·5	66·5	67·9

Danson's Table of Convict Males.

Age.	1858.	1878.
18	64·3	64·1
20	65·2	65·1
22	66·2	65·7
24	65·9	65·4
26	66·2	65·6
28	66·7	65·7
30	66·4	65·5

HEL'ENIN. See INULIN.

HELIANTHUS ANNUUS. See SUNFLOWER.

HELIANTHUS TUBEROSUS. See ARTICHOKE, JERUSALEM.

HELIOG'RAPHY. See PHOTOGRAPHY.

HEL'LEBORE. *Syn.* BLACK HELLEBORE; HELLEBORUS (Ph. L.), L. "The rhizome and root" of *Helleborus niger* (Ph. L.), or black hellebore. It is alterative and emmenagogue in small doses (2 to 8 gr.), and a drastic hydragogue purgative and anthelmintic in larger ones (10 to 20 gr.). See WHITE HELLEBORE.

HELLEBOR'INE. *Syn.* SOFT RESIN OF HELLEBORE. An odourless, acrid substance, extracted by alcohol from black hellebore, and on which, according to Vauquelin, the activity of that drug depends.

HEM'LOCK. *Syn.* CONII FOLIA (B. P.), CONIUM (Ph. L. E. and D.), L. In *pharmacy*, "the fresh and dried leaf of the wild herb *Conium maculatum*," or spotted hemlock. The first is used to make the extract; the last, the tincture and powder.

Hemlock is a powerful narcotic acrid poison, occasioning stupor, delirium, paralysis, convulsions, coma, and death. In small doses it is anodyne, alterative, resolvent, antispasmodic, and anaphrodisiac, and has been exhibited in cancer, dropsy, epilepsy, rheumatism, scrofula, syphilis, and other diseases.—*Dose*, 3 or 4 gr. of the powder, twice or thrice daily, until some obvious effect is produced.

Hemlock, whether in leaf (*conii folia*) or powder (*pulvis conii*), rapidly deteriorates by keeping. When good, the powder, triturated with solution of potassa, exhales a powerful odour of conia (smell of mice).

In cases of poisoning by hemlock, the treatment is similar to that noticed under ACONITE. See CONIA, EXTRACT, TINCTURE, &c.

HEMP. *Syn.* CANNABIS, L. In *botany*, the typical genus of the Nat. Ord. CANNABINACEÆ. The common hemp, from the fibres of which cordage is made, is the species *Cannabis sativa*. The fruit of this plant (hemp-seed) is demulcent and oleaginous. It is said that the plumage of bullfinches and goldfinches fed on it for too long a time, or in too large a quantity, changes from red and yellow to black (*Burnet*, 'Outlines of Botany').

Hemp, Indian. *Syn.* HASHISH; CANNABIS INDICA, L. This plant, now so largely used in medicine, is a variety of *Cannabis sativa*, or, perhaps, the same simply rendered more active by climate. The parts employed in Asia for the purposes of intoxication, and in Europe as medicine, are the herb or leaves and the resin. The 'gunjah' sold in the bazaars in the East Indies is the plant, just after flowering, dried, and pressed together. 'Bang,' 'bhang,' 'subjee,' or 'sidhee,' consists of the larger leaves and capsules without the stalk. The concrete resinous exudation from the leaves, stems, and flowers is called 'churrus,' and in this country 'resin of Indian hemp.' 'Hashish' seems to be a general term for any preparation of hemp.

Dr Preobraschensky has lately subjected hashish to a chemical analysis, and states that he has found an alkaloidal body, not only in the commercial substance, but also in the flower-tops of the hemp itself and the pure extract prepared from it, which was recognised as *nicotine*. Dr M. Hay also obtained an alkaloid which he named *Tetano-cannabine*.

Indian hemp is anæsthetic, anodyne, exhilarant, antispasmodic, hypnotic, and narcotic. In the East it is commonly used as an intoxicant, either by smoking it, like tobacco, or swallowing it. The inebriation produced by it is of an agreeable or cheerful character, exciting the person under its influence to laugh, dance, sing, and to commit various extravagances. It also acts as an aphrodisiac, augments the appetite for food, and, in some cases, occasions a kind of reverie and catalepsy. In this country its action is less marked. It has here been chiefly administered under the form of alcoholic or resinous extract. See EXTRACT OF INDIAN HEMP.

HEN'BANE. *Syn.* HYOSCYAMI FOLIA (B. P.), HYOSCYAMUS (Ph. L. E. and D.), L. In *pharmacy*, "the fresh leaves and flowers with the branches, also the leaves separated from the

branches of the biennial herb *Hyoscyamus niger*," or common biennial or black henbane. The first is used for preparing the extract; the last, for the powder and tincture. Its active principle is a narcotic alkaloid called *Hyoscyamine.*

Henbane is anodyne, hypnotic, antispasmodic, and sedative. It differs from opium in not being stimulant, and by not confining the bowels; and hence may be administered in cases in which that drug would be improper. In large doses it acts as a powerful narcotic poison, producing obscurity of vision, dilatation of the pupils, delirium, phantasms, coma, &c.—*Dose,* 3 to 10 gr., in powder. It is usually given in the form of extract or tincture. The antidotes, &c., are the same as those noticed under OPIUM.

HEN-COOPS, Fumigator for. On analysis this was found to consist wholly of coal-tar.

HE'PAR. *Syn.* LIVER. A name given by the older chemists to various combinations of sulphur, from their brownish or liver colour; as *hepar antimonii, hepar sulphuris,* &c. See ANTIMONY (Liver of), POTASSIUM (Sulphide), &c.

HEPIALUS HUMULI, Stephens. The Otter Moth. So called on account of the peculiar shape and size of its larvæ. It is also called the Ghost Moth, because the wings of the male are white, and in its nocturnal flights, according to Westwood, it has a singular 'pendulum-like' movement, which gives it a somewhat ghostly appearance. The body of the male is rather dusky, while the body of the female is lighter, and she has wings of a yellowish colour, with orange markings.

It is known in Germany. Taschenberg and Kaltenbach both speak of it as destructive in German hop-plantations. Near Aix its attacks were so severe that whole hop-plantations were rendered unproductive. Harris describes it as the 'hop-bine caterpillar in the roots of the hop' in his report upon American insects. The larvæ or caterpillars of this moth injure the roots of the hop by feeding upon them, biting the outside skins and piercing through the interior of the roots with their strong jaws, but the extent of their mischief is not realised as they work so low down in the earth, and their action in killing or weakening the plant is frequently attributed to other causes. As it is most abundant in this country, planters sustain more loss from this insect than they are aware of.

Life History. The perfect insect appears about the middle of June. The female soon begins to lay eggs. Though these are very plentiful, they are only deposited singly. After fourteen days the larva or caterpillar comes forth and crawls to the root of the hop-plant, or other plants, as the dock and burdock, where it remains feeding with great appetite until April. At this time it assumes the pupa stage, and emerges from the ground as the perfected imago.

Prevention. It is obviously most difficult to prevent the attacks of this insect, as the eggs are deposited at night, and are so minute that they cannot be discovered. As in the case of wireworms, application of caustic substances might prevent the attack if it were suspected. All docks, nettles, and burdocks should be removed from the immediate neighbourhood of the plantations. Moles are fond of this larva, and should be encouraged in hop-plantations.

Remedies. The only remedy of certain efficacy is to examine the roots of hop-plants that are showing unaccountable symptoms of flagging just below the crown of the plant centre. The larva is a huge caterpillar, from 1 in. to 1½ in. in length, of a dull yellow colour, easily discernible, and therefore might be picked out ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

HEPTANES. C_7H_{16}. There are 9 possible compounds of this formula in the paraffin series, of which 4 are known. Normal heptane is found in petroleum and ligroïne.

HERBAR'IUM. [Eng., L.] *Syn.* HORTUS SICCUS, L. A collection of dried specimens of plants; hence called HORTUS SICCUS, or dry garden. Plants for the herbarium should be gathered on a dry day, and carried home in a tin box ('VASCULUM'), or other convenient receptacle which will preserve them fresh for a time. Those which have collected moisture in their leaves should be allowed to dry, their stalks being placed in water to keep them alive. Plants with very thick, succulent leaves or stems must be killed by immersion in hot water before they can be safely placed in the drying press. The press consists simply of a few stout boards with a screw—or, still better, a number of heavy weights, bricks, or stones—for pressing them together. The specimens of plants, when all superficial moisture has been removed, are placed between layers of bibulous paper (BOTANICAL PAPER), care being taken that the parts of each are arranged in a natural manner. The sheets containing the specimens are then placed between the boards, and pressure is applied. This must be very gentle at first, and should be gradually increased as the plants become dry. The paper is changed every day or every second day, and the damp sheets are dried for use at a future time. When properly dried, the specimens are placed on sheets of writing-paper, and fixed by a few stitches of thread, a little gum, or strips of gummed paper. The name of the genus and species, and the locality where found, &c., are then marked beside each. Camphor or a little corrosive sublimate may be used to preserve herbaria from the ravages of insects.

HERBS. *Syn.* HERBÆ, L. The collection and drying of herbs for medicinal purposes and perfumery are noticed under VEGETABLE SUBSTANCES.

Amongst cooks, several aromatic herbs, either fresh or dried, are used for seasoning. "In many receipts is mentioned a bunch of sweet herbs, which consists, for some stews and soups, of a small bunch of parsley, 2 sprigs of thyme, and 1 bay leaf; if no parsley, then of 4 sprigs of winter savory, 6 of thyme, and 1 bay leaf" (*Soyer*).

HER'RING. A well-known small sea-fish, belonging to the family of *Clupeidæ,* a branch of the Nat. Ord. MALACOPTERYGII. As an article of food, herrings are of vast importance to a large proportion of the population of Europe. When recently caught and dressed by broiling or boiling, they are wholesome and agreeable; but if fried, or long kept, they become strong and oily, and are then apt to offend the stomach. The prepara-

tion of salted and dried or smoked herrings (bloaters, red herrings) furnishes employment for thousands, both in these countries and Holland. Real Yarmouth bloaters and Dutch herrings are highly esteemed by many as a relish. Salted herrings are said to be diuretic. The pickle was formerly used in clysters, dropsies, &c. M. Soyer calls this fish 'the poor man's friend,' and tells us that, after being "cleaned and scaled, and the head removed," it should be "opened in the back, and the gut taken out." Also that "the way to ascertain if a herring is too salt is to take the fish in left hand, and pull out a few of the fins from the back, and to taste them. You may thus find out the quality and flavour. This plan is adopted by the large dealers."

HESPER'IDIN. A peculiar substance obtained from the white portion of the rind of oranges, lemons, &c. It forms crystalline silky needles, is odourless, tasteless, fusible, soluble in alcohol and ether, less soluble in water. Hesperidin is a glucoside.

HESSIAN FLY, The (*Cecidomyia destructor*, Say). The following suggestions have been prepared by Mr Charles Whitehead, F.L.S., Agricultural Adviser to the Lords of the Committee of Council for Agriculture, for the information of agriculturists:

"Although it is believed by high authorities that the Hessian fly will not be the occasion of serious injury to wheat and barley crops in Great Britain, its continued presence and the largely extended area of its infestation must cause anxiety to those who are acquainted with the serious mischief that has very frequently been occasioned by this insect in America and in parts of Russia.

"The Hessian fly was seen first in Great Britain in 1886, and in that year did some harm to wheat and barley plants in a few places in England and Scotland.

"In 1887 it was noticed in 20 counties in England and 10 in Scotland, in some districts of which the wheat and barley crops were considerably damaged by its action. It will be remembered that the weather during the summer of 1887 was hot and dry, like that which normally prevails in America, and was presumably favourable to the development and progress of the fly.

"During 1888, whose summer was unusually wet and cold, very little was heard or seen of the Hessian fly either in England or Scotland.

"But during the present season (1890), in whose early months the temperature was high and the rainfall small, it has been found to have spread over large districts.

"From the reports received by the Agricultural Department within the past three weeks, it is manifest that the infested area has largely increased in England.

"In Scotland it does not appear to have made so much progress. Still it is present in many Scotch counties.

"The actual amount of injury to the crops is slight, and, so far as can be ascertained, is not in any instance so important as that caused in some cases in 1887.

"It is most probable that the injurious operations of the insect have been checked by the wet, cold weather which has followed the abnormal heat of May and the warmth and dryness of June. If the season had been hot and dry throughout, it is considered that the injury would have been of a far more serious nature.

"When a cycle of hot summers occurs it may happen that the ravages of the Hessian fly may be general and calamitous.

"However, it is a fact that the possible cause of grave mischief is spreading over this country, and it is therefore necessary to warn agriculturists of the danger, and to recommend the adoption of simple and practical methods of preventing the increase of this pest.

"1. Where wheat or barley crops show signs of infestation, during the threshing of these, whether this is done in the fields at harvest-time, or in rick-yards or barns later on, all the screenings and short refuse from the screens, and particularly the fine screenings, should be burnt at once or dealt with in such a way as to destroy the puparia that may be amongst them.

"The 'tail' wheat should be carefully examined and run down again if puparia are found therein. They are of the colour of a ripe horse-chestnut, and closely resemble linseed.

"2. Wheat should be sown as late as possible, in order that the autumn brood of flies may not be able to deposit eggs upon the plants.

"The sowing of winter barley and rye should be avoided in infested localities.

"At the same time care must be taken to get rid of self-sown wheat and barley plants upon which eggs might be deposited.

"3. In infested districts, wheat stubbles and barley stubbles, as far as practicable, should be ploughed up deeply directly after harvest, and skim-coulters should be used to ensure the burial of all stubble.

"4. Wheat and barley should not be sown next season in fields where the crops have been infested this year."

HEXANES. C_6H_{14}. Four hexanes are known; there are 5 possible varieties. Normal hexane occurs in petroleum, and may be obtained artificially by the action of sodium upon normal propyl-iodide.

HIC'COUGH (hĭk'-ŭp). *Syn.* HICCUP; SINGULTUS, L. A convulsive motion of the diaphragm and parts adjacent. The common causes are flatulency, indigestion, acidity, and worms. It may generally be removed by the exhibition of warm carminatives, cordials, cold water, weak spirits, camphor julep, or spirits of sal-volatile. A sudden fright or surprise will often produce the like effect. A pinch of snuff, a glass of iced soda-water, or an ice-cream will also frequently remove this affection. A glass of water drunk very slowly and continuously or the sucking of a piece of sugar will often cure hiccough.

HI'ERA-PI'CRA. See POWDER OF ALOES AND CANELLA.

HIP'POCRAS. An aromatic medicated wine, formerly much used in England, and still employed on the Continent.

Prep. Lisbon and Canary wine, of each, 12 pints; cinnamon, 2 oz.; white canella, ½ oz.; cloves, mace, nutmeg, ginger, and galangal, or cardamoms, of each, 1 dr.; bruise the spices, and

digest them in the wine for 3 or 4 days; strain, and add of lump sugar, 2½ lbs.

HIPPU'RIC ACID. $HC_9H_8NO_3$, or $C_6H_5CO.NH.CH_2.CO_2H$.

Syn. BENZOYL AMIDO-ACETIC ACID; ACIDUM HIPPURICUM, L. A compound discovered by Liebig in the urine of the horse, cow, and other graminivora, in which it exists as hippurate of potassium or sodium.

Prep. Concentrate fresh cow's urine by a gentle heat to about 1-10th its bulk, filter from deposit, mix the liquid with excess of hydrochloric acid, and set it aside to crystallise. It may be decolourised by redissolving it in boiling water, and treating it with animal charcoal, or with a little chloride of lime and hydrochloric acid, and re-crystallising it.

Obs. Hippuric acid, when pure, forms long, slender, milk-white, square prisms; it is soluble in 600 parts of cold water, and dissolves readily in hot alcohol or water. When strongly heated, it yields benzoic acid, benzoate of ammonia, and benzonitrile, with a coaly residue. The urine of horses or cows, left to itself for some time, or evaporated at a boiling temperature, yields not a trace of hippuric acid, but only benzoic acid. Nitric acid and hot oil of vitriol convert it into benzoic acid. Boiling hydrochloric acid converts it into benzoic acid and glycocoll. With the bases it forms salts, which are called hippurates. See BENZOIC ACID.

HIPS. *Syn.* HEPS; ROSA CANINA (B. P.), L. The fresh fruit of the dog-rose (*Rosa canina*), or wild briar. Used to make a conserve.

HOL'LANDS. *Syn.* GENEVA, SCHIEDAM, HOLLANDS GIN, DUTCH G. *Prep.* 1. The materials employed in the distilleries of Schiedam, in the preparation of this excellent spirit, are 2 parts of the best unmalted rye and 1 part of malted bigg, reduced to the state of coarse meal by grinding. About a barrel (36 galls.) of water, at a temperature of from 162°—168° F., is put into the mash-tun for every 1½ cwt. of meal, after which the malt is introduced and stirred, and, lastly, the rye is added. Powerful agitation is next given to the magma till it becomes quite uniform, when the mash-tun is covered over with canvas and left in this state for 2 hours. Agitation is then again had recourse to, and the transparent 'spent wash' of a preceding mashing is added, followed by as much cold water as will reduce the temperature of the whole to about 85° F. The gravity of the wort at this point varies from 33 to 38 lbs. A quantity of the best pressed Flanders yeast, equal to 1 lb. for every 100 galls. of the mashed materials, is next stirred in, and the whole is fermented in the mash-tun for about 3 days, or until the attenuation is from 7 to 4 lbs. (sp. gr. 1·007 to 1·004). During this time the yeast is occasionally skimmed off the fermenting wort. The wash, with the grains, is then transferred to the still, and converted into 'low wines.' To every 100 galls. of this liquor, 2 lbs. of juniper berries (3 to 5 years old), and about 1 lb. of salt, are added, and the whole is put into the low-wine still, and the fine spirit drawn off by a gentle heat, one receiver only being employed. The product per quarter varies from 18 to 21 galls. of spirit, 2 or 3 o. p.

2. (BEST HOLLANDS.) Hollands rectified to the strength of 24° Baumé (sp. gr. ·9125, or about 6 o. p.).

3. (ENGLISH-MADE.) *a.* From juniper berries (at least a year old, and crushed in the hands), 3 lbs.; rectified spirit, 1½ galls. (or proof spirit, 2½ galls.); digest, with agitation, for a week, and then express the liquor; after 24 hours' repose decant the clear portion, add it to good corn-spirit, at 2% or 3% o. p., 90 or 100 galls., and mix them well together.

b. From juniper berries, 2½ lbs.; sweet fennel seed, 5 oz.; caraway seed, 3½ oz.; proof spirit, 2 galls.; corn-spirit, 90 or 100 galls.

c. As the last, with the addition of Strasburg turpentine or Canada balsam, 1 lb.

d. To either of the last 2 or 3 add a very small quantity of ground cardamoms or horseradish. Some compounders also add 4 or 5 cloves of garlic, or about 15 gr. of assafœtida, with 1 gr. of ambergris rubbed to a powder with a little white sand or lump sugar. Good plain gin may be advantageously employed in lieu of the corn-spirit ordered above, when expense is no object.

Obs. The last 4 forms, which are only given as examples, produce a very pleasant spirit, if it is kept for some time to 'mellow.' Age is one of the principal causes of the 'creaminess' of foreign gin, which usually lies in bond for some time before being consumed. The product is, however, much superior if the ingredients are rectified along with 20 galls. of water, and about 14 lbs. of salt, by a gentle heat.

It will be seen from the above that the superior flavour of Hollands spirit depends more on the peculiar mode of its manufacture than on the quantity of juniper berries employed; 2 lbs. of them, when new, being barely equivalent to 1 oz. of the essential oil; and when old, to less than ½ oz., a quantity wholly insufficient to flavour 100 galls. of spirit. The Dutch distillers, most noted for this liquor, add a little pure Strasburg turpentine and a handful or two of hops to the spirit, along with the juniper berries, before rectification. The former substance has a pale yellowish-brown colour, and a very fragrant and agreeable smell, and tends materially to impart that fine aroma for which the best geneva is distinguished. At Rotterdam sweet fennel seed is commonly added as a flavouring; and at Weesoppe, Strasburg turpentine and fennel seeds, or the essential oil of fennel, are frequently substituted for a large portion of the juniper berries.

Schiedam Hollands is considered the best; the next quality is that of Rotterdam; after these comes that of Weesoppe.

Attempts have been made by Mr Robert Moore and others to introduce into general consumption in this country a home-made liquor, resembling and prepared in the same manner as foreign geneva, "but the palates of our gin-drinkers were too corrupted to relish so pure a spirit."

HOLLY (*Ilex aquifolium*, Linn.). The favourite European evergreen. The hard white wood is used in making Tunbridge ware, for the 'stringing' or lines in cabinet work, calico printers' blocks, &c. Bird-lime is the juice of holly-bark, extracted by boiling, mixed with a third part of nut oil.

Holly, Sea- (*Eryngium maritimum*, Linn.). A British sea-coast plant, the roots of which are sometimes preserved in sugar and eaten as a sweetmeat.

HOMATROPINE HYDROBROMATE. *Syn.* HOMATROPINÆ HYDROBROMAS, L. An alkaloidal salt prepared from atropine by a synthetical process. Its solution quickly dilates the pupil, the pupil rapidly regaining its normal condition. Fronmüller prefers homatropine to atropine for checking the night-sweats of phthisis. In none of his cases was there dilatation of the pupil, and in very few were there other toxic symptoms, such as dryness of the throat, &c. He also found it an immediate and certain antidote to pilocarpine. —*Dose*, $\frac{1}{100}$ to $\frac{1}{20}$ gr.

HOMŒOP′ATHY. *Syn.* HOMŒOPATHIA, L. A medical hypothesis promulgated at the commencement of the present century by the late Dr Hahnemann, of Leipsic, according to which diseases may be cured by the administration of minute doses of medicines capable of producing in healthy persons affections similar to those it is intended to remove. The doctrine that *similia similibus curantur* had long previously been practically acted on, to a limited extent, in certain cases, in legitimate medicine (allopathy, heteropathy), although not verbally recognised as belonging to its system. The administration of infinitesimal doses is an absurdity which homœopathy, however, alone can claim. According to this method, the millionth of a grain is often an excessive dose; whilst billionths and decillionths, quantities so small as to be vastly beyond human perception, form the common doses. This reduces the whole practice of homœopathy to a system of doing nothing beyond regulating the diet and habits of the patient. "All judicious practitioners have long been agreed that there are many cases which are best treated in the manner just mentioned, and in which physic does more harm than good; in which, in short, a sensible physician endeavours to amuse the patient, whilst nature cures the disorder; so that the frequent success of homœopathic treatment may be explained without admitting the principle upon which it is presumed to be founded" (*Brande*).

HON′EY. *Syn.* MEL (B. P.), L. The sweet substance elaborated by the domestic bee from the juices of the nectaries of flowers, and deposited in the cells of wax forming the honeycomb.

Var. Pure honey consists of a syrup of uncrystallisable sugar and crystalline saccharine grains, resembling grape sugar. 'Virgin honey' is that which flows spontaneously from the comb; 'ordinary honey,' that obtained by heat and pressure. The former is pale and fragrant; the latter darker, and possessing a less agreeable taste and smell. 'English honey' is chiefly collected from furze and broom flowers, and is more waxy than that from the South of Europe; 'Narbonne honey,' chiefly from rosemary, and other labiate flowers, very fine; 'poisonous honey' is found near Trebizond, in Asia, its toxic effects being due to the bees having collected it from a poisonous plant, the *Azalea pontica*.

Pur. Honey is frequently adulterated with treacle, potato-sugar syrup, potato farina, starch, and wheat-flour. The first may be detected by the colour and odour; the second in the way noticed under SUGAR; and the others by the honey not forming a nearly clear solution with cold water, and striking a blue colour with iodine. When it contains wheat-flour and is heated, it at first liquefies, but on cooling it becomes solid and tough. The absence of starchy matter or flour is easily proved by the following test:—Boiled with water for five minutes and allowed to cool, it should not become blue with iodine water—indicating absence of flour.

Uses, &c. Honey is nutritive and laxative, but rather apt to gripe. It is employed in the preparation of OXYMELS and GARGLES, and also to cover the taste of nauseous medicines, which it does better than sugar. Clarified honey is alone ordered to be used in medicine.

Honey, Clarified. *Syn.* REFINED HONEY, STRAINED H.; MEL DEPURATUM (Ph. D.), MEL PRÆPARATUM, L. The honey is simply melted by the heat of a water-bath, and strained whilst hot through flannel (Ph. D.); or it is melted as last, and the scum removed (Ph. U. S.); or it is melted with 1-3rd its weight of water, skimmed, strained through flannel, and evaporated until it reaches the sp. gr. 1·261 (P. Cod.). Honey is not to be employed without being desquamated (Ph. L.).

Obs. Clarified honey is less agreeable than raw honey, and has lost the crystalline character of the latter; but it is less liable to ferment and gripe. The use of copper and iron vessels or implements should be avoided, as honey acquires a dark colour by contact with them. Berlin ware, stone-ware, or well-silvered or tinned copper pans, should alone be used. On the large scale, one or other of the following plans are adopted:

1. The honey is mixed with an equal weight of water and allowed to boil up 5 or 6 times without skimming; it is then removed from the fire, and after being cooled, brought on several strong linen strainers, stretched horizontally, and covered with a layer of clean and well-washed sand, an inch in depth; the sand is rinsed with a little cold water, and the mixed liquor is finally evaporated to the thickness of syrup.

2. Dissolve the honey in water, as last, clarify with white of egg, and evaporate to a proper consistence.

3. Dissolve in water, add $1\frac{1}{2}$ lb. of animal charcoal to every $\frac{1}{4}$ cwt. of honey, gently simmer for 15 minutes, add a little chalk to saturate excess of acid, if required, strain or clarify, and evaporate.

4. Honey, 1 cwt.; water, 9 galls.; fresh-burnt animal charcoal, 7 lbs.; simmer for 15 minutes, add a little chalk to saturate free acid (if required), strain or clarify, and evaporate as before.

HON′EY-DEW. *Syn.* ROS MELLITIS, L. A sweetish matter ejected upon the leaves of plants by certain aphides.

HONEYS. (In *pharmacy*.) *Syn.* MELLITA, L. These are minor preparations, now almost superseded by 'syrups' (SYRUPI). The *mellita* of the Ph. B., including two 'oxymels,' are only four in number.

Honey of Bo″rax. *Syn.* MEL BORACIS (B. P., Ph. L. E. & D.), L. *Prep.* (B. P.) Finely powdered borax, 2 parts; clarified honey, 16 parts;

glycerin, 1 part; mix. Astringent, detersive, and cooling, it is employed in aphthæ of the mouth, excessive salivation, &c.

Honey of Col'chicum. *Syn.* MEL COLCHICI, L. *Prep.* (*Beasley.*) Dried colchicum, 1 part; water (at 140°), 16 parts; infuse for 12 hours; strain, let it settle, and boil the clear liquid with white honey, 12 parts, to the consistence of a syrup. See COLCHICUM.

Honey of Liq'uorice. *Syn.* MEL GLYCYRRHIZATUM, L. *Prep.* (Ph. Hamb.) Honey and a strong infusion of liquorice boiled to a proper consistence. Emollient, pectoral, and laxative.

Honey of Male Fern. *Syn.* MEL FILICIS, L. *Prep.* (*Dunglison.*) Ethereal extract of male fern, 30 gr.; honey of roses, 4 dr.; mix. In tapeworm.—*Dose.* One half at bedtime, followed by the remainder in the morning.

Honey of Ro''ses. *Syn.* MEL ROSÆ (Ph. L. and E.), L. *Prep.* 1. (Ph. L.) Dried petals of the red rose (the leaves separated), 4 oz.; boiling water, 16 fl. oz.; macerate for 2 hours; lightly press them in the hand and strain; then add 8 fl. oz. more of boiling water to the roses, macerate for a short time, and again gently express the liquor; to this add the other half; next add to the mixed liquors, honey, 5 lbs.; and evaporate in a water-bath, so that, the infusion which was set aside being added, it may become of a proper consistence.

2. (Ph. E.) Dried rose petals, 4 oz.; boiling water, 2½ pints; infuse for 6 hours, and gently squeeze out the liquor; after the impurities have subsided, decant the clear, add of honey, 5 lbs., and evaporate as before to a proper consistence, removing the scum which forms. Used to make astringent gargles. It must not be boiled in a copper or iron vessel, as it will spoil the colour. The last form is that commonly adopted in trade.

Honey of Squills. *Syn.* MEL SCILLÆ, L. *Prep.* 1. Thick clarified honey, 3 lbs.; tincture of squills, 2 lbs.; mix.

2. (*Soubeiran.*) Dried squills, 1 oz.; boiling water, ¾ pint; infuse 2 hours, strain, add of honey, 12 oz., and evaporate to a proper consistence. Resembles OXYMEL OF SQUILLS (nearly).

Honey of Verdigris. EGYPTIACUM.

Honey of Violets. *Syn.* MEL VIOLÆ, L. *Prep.* From clarified honey, 2 parts; expressed and depurated juice of violets, 1 part. Resembles syrup of violets.

HOOP'ING-COUGH. See WHOOPING-COUGH.

HOOSE. Young cattle, especially calves, as well as sheep and lambs, are frequently liable to attacks of a species of bronchitis, caused by the presence in the bronchial tubes of minute worms, *Strongylus filaria.* They are mostly so attacked in autumn, the disease prevailing especially on low, damp land. The parasites are found in the stomach and intestines frequently, when they cause a species of dysentery; when in the lung, there is much coughing, rubbing of the nose on the ground, and quickened respiration, especially in young animals.

Treatm. Feed lambs on fresh pastures, on hill-sides, and in dry places, avoiding old pastures; those affected may be treated by inhalations of chlorine, or better, sulphurous acid; this can be done by shutting the animals up in a closed room and burning sulphur in it; care must be taken not to kill them by the treatment. When the parasites are in the intestine, several doses of turpentine are recommended. The food should be good and stimulating, with salt.

Hoose in calves is due to *Strongylus micrurus,* and may be treated in the same way as in sheep, viz. by inhalations and purgatives, care being taken to keep the healthy animals away from the sick, as the ova of the parasite may be in the dung, and so find their way to a new host.

HOPS. *Syn.* LUPULUS (B. P.), L. "The catkins of the female plant of the *Humulus lupulus,*" or common hop (B. P.). "The dried strobiles" (Ph. D.). The hops of commerce are the strobiles or catkins (LUPULI STROBILI, L. AMENTA) of the hop-plant. The yellow powder or small lupulinic grains or glands (LUPULIN), which are attached to the strobiles, are the portion on which their characteristic qualities chiefly depend.

The hop is tonic, stomachic, and moderately narcotic. It is used in diseases of local debility with morbid vigilance and other nervous derangement, producing sleep where opiates are objectionable. Hops may be used topically as a fomentation or a poultice, as a resolvent or discutient in painful swellings and tumours. The golden dust attached to the scale of the hop is sometimes administered in doses of from 5 to 10 grains. Very freshly dried hops, made into a pillow, procure sleep.

In the choice of hops, care should be taken to select those that have large cones or strobiles, that are the most powerfully odorous and most free from leaves, stems, scaly fragments, and sticks, and which, when rubbed between the hands, impart, in the greatest degree, a yellowish tint and glutinous feeling to the skin. The tightness with which they are packed should also be noticed; as, without being very firmly pressed together, and quite solid, they soon spoil by keeping. The finest flavoured hops are the 'GOLDINGS,' grown chiefly in Middle and East Kent; the 'WHITEBINES' of Farnham and Canterbury; and the WORCESTER HOPS, grown on the red soils of the vale of the Severn. These are principally employed for the finer class of ales. Mid Kent and Sussex hops are also used for ale, but have an inferior colour and flavour. The best hops are packed in sacks of fine canvas, termed 'pockets,' weighing from 1¼ cwt. to 1¾ cwt. each; and the inferior qualities in coarse 'bags,' of about double the size. The former are mostly purchased by the ale brewers, and the latter by the porter brewers. When hops are older than of last season's growth they are termed 'yearlings,'—when of the second season's growth, 'old,'—and when three years or older, 'old olds.' See BREWING, EXTRACT, HUMULIN, LUPULIN, TINCTURE, &c.

HORE'HOUND. *Syn.* WHITE HOREHOUND; MARRUBIUM VULGARE, Linn., L. This herb has long been a popular remedy in chronic pulmonary complaints, especially catarrh, and in uterine and liver affections. Horehound tea (THEA MARRUBII, INFUSUM MARRUBII) is prepared by infusing 1 oz. of the herb in boiling water,

1 pint, for 1 hour; syrup of horehound (SYRUPUS MARRUBII), by thickening the infusion of tea with sugar; candied horehound (MARRUBIUM CONDITUM), by mixing 1 pint of horehound juice with 8 or 10 lbs. of white sugar, boiling the mixture to a candy height, and pouring it, whilst warm, into moulds or small paper cases, well dusted with finely powdered lump sugar; or by pouring it out on a dusted slab, and cutting it into squares. See CANDYING.

HORN. For the purposes of the turner and comb-maker, horns of the goat and sheep are preferred on account of their superior whiteness and transparency. For medical purposes, those of the stag (HARTSHORN) are ordered to be employed.

Horn is dyed with the same dyes and in a similar manner to bones and ivory.

Horn is softened, bent, and moulded by means of heat and pressure. For these purposes boiling water and a screw-press are commonly employed.

Horn is reduced to plates or sheets by sawing it, and then exposing it to powerful pressure between hot iron plates; the pith having been previously removed, and its texture softened by soaking for some days in water, and subsequent boiling in that liquid.

Surfaces and edges may be united or cemented together by softening the horn by the heat of boiling water, placing the parts in contact under strong pressure, and exposing the whole thus arranged to the heat of boiling water.

Horn is stained or party-coloured to imitate tortoiseshell, by a solution of terchloride of gold for the red portion; nitrate of silver for the dark brown and black; and nitrate of mercury (hot), or a paste made of red-lead, and potash or quick-lime for the brown. When the last is used the horn must be heated and exposed to its action for some hours.

HORNBLENDE. *Syn.* AMPHIBOLE. A silicate and aluminate of magnesium, calcium, and iron, with a variable proportion of the fluorides of calcium and potassium. It is found in dark green or black crystals, or in a massive form. Asbestos is a fibrous variety of hornblende.

HORN SILVER. AgCl. A native chloride of silver, which occurs either crystallised in cubes, or as a compact semi-transparent mass. See SILVER.

HORS-D'ŒUVRES. [Fr.] *Syn.* ASSIETTES, Fr. Small *entrées*, as *aiguillettes*, *ragoûts*, plates of sardines, anchovies, or other relishes, served at dinner between the leading dishes. *Assiettes volantes* (flying plates) are dishes handed round to the guests, but not placed on the table.

HORSE. *Syn.* EQUUS, L. This most useful quadruped belongs to the family *Equidæ*, distinguished by a single digit and hoof on each foot. The horse can scarcely be said to exist at the present day in its natural wild state, as the so-called 'wild horses' of America and Asia are but the progeny of horses which have escaped from the haunts of civilisation. Of all animals the horse is most useful to man. Independently of its value as a beast of burden and draught, its skin, its hide, intestines, and bones furnish us with leather, the thongs of whips, gut, grease, bone-black, manure, &c. The excrement, fat, and hoof were included in the Materia Medica of the Ph. L., 1618. The flesh is eaten in some countries, and was formerly esteemed to possess many virtues.

Injuries of a serious character, and even death, are often occasioned by horses running away, or becoming unmanageable. Various methods have been proposed to prevent accidents of this kind, and to place the animal entirely under the power of its rider or driver. In Russia, around the horse's neck, near the neck strap, is placed a cord with a running knot. To this slip-noose is attached a pair of reins, which always lie thrown over the dashboards, ready to be seized at once. When the horse starts, and becomes unruly, the gentleman takes up this cord, and tightens the horse's throat, so that he cannot take breath. The most furious horse stops instantly, and will not fall or kick. See BEDDING, BRAN MASH, BROKEN KNEES, BROKEN WIND, CLIPPING, CANKER, CATARRH, CHOKING, CHOREA, COLIC, CONSTIPATION, CORNS, CRIB-BITING, CURB.

HORSE-BALLS. See VETERINARY MEDICINE.

HORSE-POW'ER. This term was first employed by James Watt to express a power capable of raising 33,000 lbs. 1 foot high per minute. The effective pressure on the surface of the piston was estimated at 7 lbs. to the square inch, and hence the area of the piston, in square inches, multiplied by 7, gave the gross effective moving pressure, and the space passed over by this piston in a minute gave the distance through which the pressure was exerted, or the weight was raised. From these data the horse-power was easily calculated. In process of time improvements in the formation of boilers and steam engines increased the effective pressure on the piston, and, consequently, the power of the engine. In modern engines the actual power is commonly from 2 to 4 times greater than the nominal power, which is, however, still retained as the unit of power in commercial calculations.

HORSERAD'ISH. *Syn.* ARMORACIÆ RADIX (B. P.), L. "The fresh root of *Cochlearia armoracia*" (B. P.). Horseradish is pungent, acrid, stimulant, and rubefacient. It is also regarded as diaphoretic, diuretic, and antiscorbutic. It forms a useful masticatory in hoarseness, sore throat, and toothache. As a condiment, it provokes the appetite and assists digestion. Reduced to shreds (scraped horseradish), it forms a common and excellent accompaniment to roast beef. The root of aconite or wolfsbane, which somewhat resembles it in appearance, has occasionally been mistaken for it, with fatal results; the two are, however, readily distinguished from each other, as the taste of horseradish is warm and pungent, approaching that of mustard, whilst aconite is bitter, and its odour is earthy and disagreeable, and after a few minutes' contact with the lips, tongue, and fauces, produces a sensation of numbness and tingling. See ACONITUM NAPELLUS, under which article will be found engravings of the two roots. The root may be kept fresh for some time if buried in sand in a cool place. Horseradish powder is prepared from the roots gathered in November or December, and dried by a gentle heat or exposure to a current of dry air. It is used as a condiment.

HORSES, Condition Powder for. The principal ingredients were: Fenugreek, liquorice-root, resin, brimstone, common salt, nitrate of potash, and a green powder, probably senna. It contained traces of calcium and magnesium carbonates; alumina, silica, and iron.

HOR'TUS SICCUS. See HERBARIUM.

HOS'PITAL GAN'GRENE. *Syn.* PHAGEDÆNA GANGRENOSA, L. A species of ulcerating mortification, particularly characterised by its infectious nature and its tendency to attack wounds and ulcers in crowded hospitals, so that often the most trifling operation cannot be performed with safety. Under its influence the parts are rapidly destroyed, not by the formation of ordinary sloughs, as in common mortification, but by their conversion into an ash-coloured viscid substance interspersed with bloody specks.

The disease now rarely occurs except in war, and when it shows itself the hospital should be broken up and the patients placed in tents or huts.

HUILE. [Fr.] Oil; a term applied to various substances and preparations on account of their smoothness, consistence, or real or imaginary emollient or oleaginous nature. See LIQUEUR, OIL, &c.

Huile Acoustique. *Prep.* From garlic and bay leaves, of each, ½ oz.; olive oil, ½ lb.; boiled together for 15 minutes, and strained. Used in earache and deafness. A little is dropped on cotton-wool and placed in the ear.

Huile, Antique. See OILS (Hair).

Huile Liqueureuse. *Prep.* 1. (DE LA ROSE.) From eau de rose, 1 part; simple syrup, 2 parts; mixed together.

2. (DES FLEURS D'ORANGES.) From orange-flower water and syrup, as No. 1.

3. (DE VANILLE.) From essence of vanilla, 1 dr.; simple syrup, 1 pint.

Obs. The above are kept in small decanters, and used to flavour water, grog, liqueurs, &c., instead of sugar or capillaire; also to perfume the breath. Other flavoured syrups, for the same purposes, are prepared in a similar manner.

HU'MIC ACID. *Syn.* ULMIC ACID. See HUMUS.

HUMULIN. The name given to a beautiful extract or essence of hops, made as follows:

A concentrated tincture of hops is prepared by percolation with rectified spirit; the same hops are then exhausted with water; the spirit is removed from the tincture by careful distillation, and the upper aqueous portion is skimmed off and added to the infusion, which latter is then evaporated to the consistence of a soft extract; the oleo-resinous residuum of the tincture is next added, and well mixed in; after which the whole is put into pots and carefully tied over for sale. The product possesses all the fragrant, tonic, and bitter qualities of the hop in a highly condensed form. See HOPS, LUPULIN, &c.

HU'MUS. *Syn.* ULMIN. When wood or woody fibre is exposed to the joint action of air and moisture, it decays and crumbles down into a dark brown or black powder, commonly called 'mould,' to which chemists have given the name of 'humus.' In this state it exists in fertile soils, being derived from the decay of plants. A powder of similar composition is produced by the action of powerful chemical reagents on sugar, lignin, &c. When acted upon by dilute boiling solution of caustic potash, this substance yields a deep brown solution, from which acids precipitate a flocculent brown substance generally called 'ulmic' or 'humic acid.' Both bodies require further investigation, as they are supposed to vary exceedingly in composition.

HUNGER. The peculiar sensation arising from the want of food. When severe, it increases to actual pain, the respirations become less frequent, the circulation languid, and there is a general diminution of the heat of the body and of the secretions. The return of hunger is accelerated by exercise and labour, and by the exposure of the body to a low temperature. Long fasting is injurious, more particularly to the young and the debilitated. See APPETITE, NUTRITION, &c.

HY'ACINTH. In *botany*, the English name for the genus *Hyacinthus.* There are numerous varieties of the garden hyacinth, all very beautiful. The bulbs are largely imported from Holland, and are often grown in water contained in suitable glass vessels (hyacinth glasses). In *mineralogy*, the term is applied to crystallised yellow or brown zircon. See GEMS.

HYDRAC'IDS. *Syn.* HYDROGEN ACIDS. A name formerly given to those acids which do not contain oxygen, as hydrochloric, &c. It is still occasionally employed.

HY'DRAGOGUES. *Syn.* HYDRAGOGA, L. Medicines which cause the removal of water from any of the cavities of the body. Many cathartics, as gamboge, jalap, &c., are classed under this head.

HYDRAS'TIN. The name given to a concentrated remedy much employed by the medical eclectics of America.

Prep. Treat the powdered root of golden seal (*Hydrastis canadensis*) with cold water by percolation; acidulate the infusion with hydrochloric acid; collect the precipitate on a filter; then dry it, dissolve the dried mass in alcohol, filter, and set aside to crystallise.

Prop. Yellow, acicular crystals, insoluble in cold alcohol, ether, and water.—*Dose,* 3 to 5 gr., 3 to 6 times a day; as a tonic in dyspepsia, inflammation of the stomach, &c.

Obs. According to the most recent investigations, hydrastin contains berberine, and another alkaloid called hydrastia or hydrastina.

HYDRASTINE. *Syn.* HYDRASTINA. The chief alkaloid and active principle of golden seal. In white prismatic crystals, insoluble in water; soluble in alcohol, chloroform, and ether. Action antiperiodic; used in fevers.—*Dose,* 1 to 4 gr.

HYDRASTIS CANADENSIS. *Syn.* GOLDEN SEAL, INDIAN DYE, ORANGE ROOT, YELLOW ROOT. This is a small herbaceous perennial North American plant, belonging to the Nat. Ord. RANUNCULACEÆ. The rhizome, which is the officinal part, though yellow in the recent root, becomes of a dark yellowish brown by age. It contains albumen, starch, fatty matter, resin, yellow colouring matter, sugar, lignin, and various salts; also a peculiar nitrogenous crystallisable substance, to which Dr Durand, the discoverer, proposed the provisional name of hydrastin, which substance will be found described above. The root of the golden seal, and also the alkaloids

obtainable from it, are largely used in American medical practice, and are stated to possess valuable tonic, aperient, diuretic, and deobstruent powers. They have been employed in dyspepsia, jaundice, and functional disorders of the liver. They are also regarded as one of the best substitutes for quinine in intermittents.

Golden seal has been given in the form of infusion, decoction, tincture, and extract, and the fluid extract is now officinal in the United States Pharmacopœia.

HY'DRATES. Compounds of hydroxyl (HO) with other bodies, *e.g.* KHO—hydrate of potassium. The term hydrate is also given to chemical combinations of water (H_2O) with other substances, *e.g.* C_2HCl_3O,H_2O—hydrate of chloral.

HY'DRIDE. A compound of hydrogen with another radical, *e.g.* hydride of methyl—CH_3H; antimony hydride—SbH_3.

HYDRI'ODATE. A name formerly given to the salts now termed iodides. See IODIDES.

HYDRIODIC ACID. *Syn.* IODHYDRIC ACID; ACIDUM HYDRIODICUM, L. An acid composed of hydrogen and iodine, HI.—*Prep.* Hydrogen and iodine unite directly at a red heat, but the usual method of preparation is by the action of water upon a mixture of iodine and red phosphorus. The iodine and phosphorus are mixed in a flask, and the water run in through a separating funnel in small quantities at a time.

It may also be prepared by passing sulphuretted hydrogen through water containing finely divided iodine in suspension, and distilling the solution.

Prop. It is a colourless gas, which fumes strongly in the air. It dissolves very readily in water. The dry gas may be collected over mercury, or by displacement of air. It is decomposed by chlorine or bromine, the iodine being liberated.

Tests. Silver nitrate solution gives a light yellow precipitate, insoluble in nitric acid or ammonia.

Heated with sulphuric acid and manganese dioxide, violet vapours of iodine are evolved.

It is much used in the laboratory as a powerful reducing agent.

HYDROBENZAMIDE. *Syn.* TRIBENZYLENE DIAMINE. $(C_6H_5,Ch)_3N_2$. A white crystalline mass obtained from oil of bitter almonds by treatment with ammonia.

HYDROBROMIC ACID. HBr. *Syn.* HYDRIC BROMIDE. *Prep.* This acid may be obtained by the direct union of hydrogen and bromine on passing the mixed gases through a red-hot tube, or on passing a series of electric sparks through them. The usual method is as follows:—Suspend 1 part of amorphous phosphorus in 15 parts of water, and gradually mix with 10 parts of bromine by means of a separating-funnel; hydrobromic acid gas is rapidly evolved, and may be collected by displacement of air, or dissolved in water to form the aqueous acid.

It may also be prepared by treating bromine water with sulphuretted hydrogen, filtering from the precipitated sulphur, and distilling from the sulphuric acid formed; also by dropping bromine upon paraffin heated to 150° F.

Prop. Hydrobromic acid is a colourless gas which fumes strongly in the air, and is rapidly absorbed by water. Chlorine decomposes it with the liberation of bromine. Metallic peroxides also decompose it exactly as in the case of hydrochloric acid.

Tests. Silver nitrate solution gives a yellowish-white precipitate, insoluble in nitric acid or ammonia. Heated with sulphuric acid and manganese dioxide, reddish-brown fumes of bromine are evolved.

HYDROCARBON. A compound of carbon and hydrogen. There are several series of hydrocarbons, of which the most important are the paraffin and the benzene groups. The simplest member of the paraffin series is marsh-gas, CH_4; the general formula is C_nH_{2n+2}. The members form what is known as an homologous series, the formula of each member differing from that of the member below it by the group CH_2, thus:

Methane, CH_4;
Ethane, C_2H_6;
Propane, C_3H_8;
Butane, C_4H_{10}; &c.

See PARAFFINS.

The benzene series, or aromatic hydrocarbons, are derivatives of benzene, C_6H_6, the lowest member of the group.

Some of the members are—

Benzene, C_6H_6;
Toluene, C_7H_8;
Xylene, C_8H_{10}; &c.

The hydrocarbons of this series are obtained from coal-tar by distillation.

There are also two other series of some importance:

The ethylene series, general formula C_nH_{2n}.
„ acetylene „ „ C_nH_{2n-2}.

See BENZENE, ETHYLENE, ACETYLENE.

HYDROCHLORIC ACID. HCl = 36·6. *Syn.* MURIATIC ACID, HYDRIC CHLORIDE, HYDROGEN CHLORIDE. This important gaseous compound was discovered by Priestley in 1772. In nature it is given off with other gases from active volcanoes, and is occasionally to be met with in the springs and rivers of volcanic districts. When hydrogen and chlorine are mixed in equal volumes, they are without action upon each other if kept in the dark; but if exposed to direct sunlight, chemical combination, accompanied by a loud explosion, instantly takes place between them, the result of their union being the colourless gaseous hydrochloric acid. If, instead of bright sunshine, the mixed gases are exposed to diffused daylight, chemical union also ensues between them, but the process is then a slow and gradual one; the passage through them, however, of the electric spark, or the application of a lighted match or taper, instantly causes their explosion and combination.

One volume of chlorine unites with 1 volume of hydrogen, forming 2 volumes of hydrochloric acid; no condensation occurs in the act of union.

Hydrochloric acid may also be formed by transmitting moist chlorine through a red-hot porcelain tube, oxygen being at the same time liberated.

Prep. Hydrochloric acid, save for the purposes of illustrative experiment, is never obtained by any of the above processes. An easy mode of procuring it, when required for laboratory use, is to heat the ordinary aqueous solution of the acid

in a flask, and to collect the gas, which is given off by displacement. It may also be readily got by introducing pieces of common salt (which should have been previously fused in a crucible at a red heat and allowed to cool) into a glass retort, and pouring over them about twice their weight of oil of vitriol. The hydrochloric acid, which escapes very abundantly, must be collected either by displacement or over mercury.

Prop. Hydrochloric acid is a colourless gas, very acid to the taste, and irritating to the eyes; it induces coughing even if breathed in small quantities, or when largely diluted. It is very destructive to vegetation, and on this account the soda manufacturer is compelled by law to condense and thus prevent the escape of its fumes. It has a sp. gr. of 1·261 (sp. gr. of air = 1). When subjected to a pressure of 40 atmospheres at 50° F., it becomes a colourless fluid capable of dissolving bitumen, and having a sp. gr. of 1·27. It has never been frozen. Hydrochloric acid neither burns nor supports combustion. The white fumes which it forms when exposed to the air are due to its condensing the atmospheric moisture, and thus giving rise to a body less volatile than water. This gas is greedily and instantly absorbed by water. A fragment of ice placed in a jar of the gas absorbs it, and becomes immediately dissolved.

Hydrochloric Acid, Solution of. The hydrochloric acid of commerce is a solution of the above gas in water. When exposed to the air it emits grey fumes. Water at 40° F. absorbs about 480 times its bulk of hydrochloric acid, increasing in volume about 1-3rd in doing so, acquiring a density of 1·2109, and then containing nearly 43% of the acid.

Strength of Solution of Hydrochloric Acid, 77° F. (E. Davy.)

Sp. Gravity.	Hydrochloric Acid in 100 parts.	Sp. Gravity.	Hydrochloric Acid in 100 parts.
1·21	42·43	1·10	20·20
1·20	40·40	1·09	18·18
1·19	38·38	1·08	16·16
1·18	36·36	1·07	14·14
1·17	34·34	1·06	12·12
1·16	32·32	1·05	10·10
1·15	30·30	1·04	8·08
1·14	28·28	1·03	6·06
1·13	26·26	1·02	4·04
1·12	24·24	1·01	2·02
1·11	22·22		

In the *laboratory*, solution of hydrochloric acid is in constant use. It may be easily prepared from chloride of sodium and sulphuric acid. The retort should be connected with a couple of Woulfe's bottles, into the first of which a small quantity of water should be poured, to detain any impurities mechanically carried over with the gas; the second bottle should contain 4 parts of water, and should be placed in a vessel of cold water, as the gas in becoming condensed disengages a large amount of heat. The gas comes off and is absorbed readily by the water upon applying a gentle heat to the retort.

It is on this principle that solution of hydrochloric acid is obtained in such enormous quantities for the various purposes in which it is used in the *arts* and *manufactures.*

Hydrochloric acid is, in fact, a by-product in the manufacture of carbonate of soda, and is generated during the first stage of the operation, known as the salt-cake process, which consists in the decomposition of salt by sulphuric acid, and is accomplished in a furnace called the salt-cake furnace.

The hydrochloric acid gas which is given off escapes from the furnace through a flue with the products of combustion into high brick towers filled with coke or stones, over which a stream of water trickles down; the whole of the acid vapours are thus condensed, the smoke passing off by a chimney connected with the towers. For further particulars and diagrams, see Soda.

"A saturated solution of hydrochloric acid in water has the specific gravity of 1·21; and when heated in a retort, loses at first hydrochloric acid gas, but after a time an aqueous acid distils over, at the ordinary atmospheric pressure, containing 20·22% of hydrochloric acid, and boiling constantly at 110° C. If the distillation be conducted under diminished pressure, the liquid boils at a lower temperature, and attains a composition which is different for each boiling-point; hence the dilute acids thus obtained by boiling the solution of hydrochloric acid gas in water cannot be considered as definite compounds of hydrochloric acid and water" (*Roscoe* and *Dittmar*).

Commercial hydrochloric acid is usually of a yellow colour, owing to its being contaminated with iron. It also very frequently contains sodium, arsenic, sulphuric and sulphurous acids, and free chlorine.

Pure aqueous solution of hydrochloric acid should leave no residue upon evaporation; it should give no precipitation of ferric oxide when saturated with ammonia; sulphuretted hydrogen should cause no turbidity in it; if diluted with 3 or 4 times its volume of water, and chloride of barium be added, no white cloud or precipitate should form in the mixture; nor should the acid, if pure, discolour a fluid made faintly blue with iodide of starch.

Hydrochloric acid is largely consumed in the manufacture of chlorine, sal-ammoniac, antimony chloride, glue, phosphorus, in the preparation of carbonic acid for the manufacture of artificial mineral waters, in beetroot sugar works, hydrometallurgy, and alone, or mixed with nitric acid, for dissolving various metals (*Wagner*). See Acids, Effects of, on Vegetation; Chlorine.

HYDROCHLORIC ETHER. C_2H_5Cl. *Syn.* Ethyl chloride, Chloride of ethyl. This ether may be obtained either by saturating alcohol with hydrochloric acid gas, and then distilling at a gentle heat, or by distilling a mixture of 3 parts of oil of vitriol, 2 parts of alcohol, and 4 parts of fused chloride of sodium; the retort is in either case connected with a tubulated receiver, surrounded by water at a temperature of about 68° F., in which most of the alcohol and water which pass over during the operation becomes condensed,

whilst the ether escapes in the form of vapour through a bent tube, which is inserted into the tubulure of the receiver, and passes to the bottom of a flask kept cool with ice. The liquid which is condensed in the flask must be rectified from calcic chloride.

Hydrochloric ether is a colourless liquid, having a sp. gr. at 32° F. of 0·921, and a boiling-point of 51·9° F. The sp. gr. of its vapour is 2·219. It has an ethereal, penetrating, somewhat garlicky odour. It is sparingly soluble in water, but readily so in alcohol. These solutions fail to give a precipitate with argentic nitrate.

HYDROCOTYLE ASIATICA. An umbelliferous herb. Alterative and diuretic; largely used in the East as a remedy for leprosy, syphilitic and skin affections, ozæna, and a number of other diseases. —*Dose*, 10 gr., in powder, 3 times a day; and locally as a poultice to ulcers, a snuff in ozæna, and an ointment mixed with lard in various skin diseases.

HYDROCYANIC ACID. HCN. HCy. *Syn.* PRUSSIC ACID, HYDRIC CYANIDE, CYANHYDRIC ACID. Hydrocyanic acid was discovered by Scheele, but its nature and chemical properties were first investigated by Gay-Lussac.

Sources. This acid is found in water distilled from the kernels of the apricot, the peach, the plum and cherry, the leaves of the laurel, and some other shrubs. The kernels of the bitter almond also yield it by distillation, mixed with an essential oil. The juice of the tapioca plant (the *Jatropha manihot*) likewise contains it. Many nitrogenous substances, when submitted to destructive distillation, also evolve hydrocyanic acid. Crystallised ammonic formate heated in a retort yields a vapour which, passed through a red-hot tube, decomposes into this acid and water. Another method by which it may be obtained consists in sending a current of dry sulphuretted hydrogen gas through a long tube filled with cyanide of mercury; and it has been obtained by the direct combination of nitrogen and acetylene gas, by adding 1 volume of the former to 2 of the latter, and passing a series of electric sparks through the mixture, the gases combining without condensation. Lastly, it is yielded when a metallic cyanide or ferrocyanide is decomposed by an acid, this latter being the means by which it is invariably procured.

1. ANHYDROUS HYDROCYANIC ACID may be prepared by Wöhler's plan, which is as follows:—A crude potassium cyanide is prepared by fusing 8 parts of the dried potassium ferrocyanide with 3 parts of potassium carbonate and 1 part of charcoal.

The fused mass is treated with 6 times its weight of water in a well-closed vessel; the clear liquid is decanted from the iron, which it is the object of this operation to separate, and is poured into a retort; sulphuric acid, diluted with an equal weight of water, is gradually added in the proportion of 1 part of oil of vitriol to 2 parts of the cyanide. At first the distillation proceeds spontaneously from the heat developed by the admixture of sulphuric acid with the water. In order to condense the acid, the products are made to pass through a long U-shaped tube, immersed in cold water and filled with calcic chloride, with the exception of the first fourth of the tube, which contains fragments of the crude potassium cyanide; to the bent tube is attached a second delivery-tube, which passes to the bottom of a bottle cooled with ice and salt. The calcic chloride in the syphon tube retains the moisture, and the potassic cyanide any sulphuric acid that might chance to pass over, whilst the hydrocyanic acid collects in the anhydrous state in the cooled receiver.

It may also be prepared by the dehydration of the strong aqueous acid, by means of fused and pulverised chloride of calcium. The details of this process are given in 'Watt's Chemical Dictionary.'

⁂ The observance of the greatest caution is necessary in the preparation of this most potent poison. The apparatus should be so arranged that any vapours given off are carried from the operator by a brisk current of air.

Prop. At ordinary temperatures anhydrous hydrocyanic acid is a colourless liquid, having a sp. gr. of 0·7058 at 44·6° F. It is very inflammable, burning with a violet flame resembling that of cyanogen, but somewhat whiter in colour. It is soluble in all proportions in water, the resulting mixture being lighter than that fluid, and miscible with alcohol. It is very feebly acid, potassic cyanide always having an alkaline reaction. Red oxide of mercury is readily dissolved by it, and when added to a solution of argentic nitrate it precipitates white flocculi of cyanide of silver. Anhydrous hydrocyanic acid is an extremely volatile liquid; if a drop be let fall on a glass plate, part of it becomes frozen by the cold produced by its own evaporation.

2. PREPARATION OF AQUEOUS HYDROCYANIC ACID.

a. From Hydrated Ferrocyanide of Potassium. By heating it in a glass retort with oil of vitriol and water, Everitt states that the best proportions are nearly 10 parts of the salt to 7 of oil of vitriol (diluted with any convenient amount of water). It is necessary to employ a good condensing apparatus, or the hydrocyanic acid which passes over at first will for the most part be dissipated in vapour mixed with the air of the apparatus. This loss may also be obviated by placing water in the receiver.

b. From Cyanide of Potassium (without distillation). To a solution of 9 parts of tartaric acid in 60 parts of water, contained in a well-stoppered bottle nearly filled with it, 4 parts of pure cyanide of potassium are added; the vessel is shaken, frequently dipped into cold water, and then left in the cold for 12 hours; and the aqueous hydrocyanic acid, which contains but a very small quantity of tartrate of potassium, is poured off from the crystallised tartrate ('London Med. Surg. Journ.,' vi, 524). This acid contains 3·6% of anhydrous hydrocyanic acid.

It may also be prepared from cyanide of mercury by shaking it with dilute sulphuric acid and iron filings, and distilling the solution obtained; also from cyanide of silver by shaking it with hydrochloric acid; and from chloroform and ammonia when heated together, ammonium chloride being formed at the same time.

Prop. The aqueous is very similar in properties to the anhydrous acid, differing in taste, odour, poisonous and combustible properties, ac-

cording to its degree of concentration. Like the anhydrous, the aqueous acid decomposes, but not so readily; becoming brown, and at last black. A little free mineral acid assists to preserve it. It should be always kept in a dark place.

Detection and Estimation of Hydrocyanic Acid and Soluble Cyanides. The presence of hydrocyanic acid, indicated by the characteristic smell which is given off by the contents of the stomach or of any fluid containing it (provided this is not disguised by any substance of stronger odour), may be confirmed by the following tests:

1. To the filtered suspected fluid add a slight excess of caustic potash, and then a solution containing ferrous and ferric sulphates. If hydrocyanic acid or a soluble cyanide be present, upon the addition of an excess of hydrochloric acid the liquid turns to a blue colour (more or less intense according to the quantity of acid present), owing to the formation of Prussian blue.

2. Add to the suspected fluid a solution of nitrate of silver; if hydrocyanic acid be present, a white precipitate of cyanide of silver is formed, which is nearly insoluble in cold nitric acid, but is soluble in ammonia and cyanide of potash, and which, when heated to redness, gives off the inflammable violet-flamed cyanogen.

3. Acidulate a small quantity of the suspected liquid with a few drops of hydrochloric acid, and place it in a watch-glass; then invert a second watch-glass, moistened with a drop of solution of ammonic sulphide, over this. After a few minutes remove the upper watch-glass, and evaporate the liquid to dryness over a water-bath; let the dry residue be treated with a drop of a weak solution of ferric chloride. If hydrocyanic acid be present a blood-red colour is produced, owing to the formation of red ferric, which may be discharged by chloride of mercury; a reaction which distinguishes it from a similar colour given by meconic acid.

Where large quantities of material have to be examined, it is desirable that the acid should be distilled off by the heat of a water-bath, acidulating the liquid with tartaric acid if it be alkaline. The distillate is then to be tested by any of the above methods.

Antidotes. Give a scruple of carbonate of potash dissolved in about an ounce of distilled water, and directly afterwards 10 gr. of sulphate of iron, also dissolved in the same quantity of distilled water, to which should be added 1 dr. of tincture of perchloride of iron. Whilst this is being prepared, and subsequently, apply cold affusion to the head and neck, artificial respiration, and, if practicable, give strong coffee and brandy. A more ready remedy is ammonia, given both internally and applied to the nostrils.

HYDROFLUORIC ACID. HF. *Syn.* Fluohydric acid, Fluoride of hydrogen, Hydric fluoride; Acidum hydrofluoricum, L. A compound of hydrogen and fluorine analogous in composition and chemical properties to hydrochloric, hydrobromic, and hydriodic acids. Discovered by Scheele, but first obtained pure by Gay-Lussac and Thènard in 1810.

Prep. 1. From *fluor-spar* (free from silica and metallic sulphides) and oil of vitriol. The fluor-spar being reduced to fine powder and placed in a leaden retort, is mixed with twice its weight of concentrated oil of vitriol, and on applying heat, a highly acid vapour distils over, which condenses to a liquid if passed into a receiver of the same metal, standing in a freezing mixture at a temperature of 4° F. Louyet has shown that the liquid acid, obtained as above, is not (as once believed) anhydrous.

2. From the double fluoride of potassium and hydrogen. Fremy's method is to render the salt anhydrous by careful drying, and by the subsequent application of a strong heat to expel the equivalent of hydrofluoric acid contained in it; it is condensed into a colourless, mobile, very volatile liquid by the application of a freezing mixture of ice and salt.

3. By decomposing plumbic fluoride by dry hydrogen.

Prop. The strong, aqueous hydrofluoric acid obtained by the action of oil of vitriol on fluor-spar is a densely fuming, volatile, colourless liquid, which boils at 15·5° C. It combines with water so greedily, and evolves so much heat in doing so, as to give rise to a hissing noise like that produced when a red-hot iron is plunged into cold water. In a concentrated form it has a sp. gr. of 1·060. Brought into contact with animal matter of any kind it instantly destroys it, the smallest drop on the skin producing a deep and painful wound; hence the necessity of the greatest care in its preparation. With the exception of platinum, gold, silver, mercury, and lead, hydrofluoric acid, when diluted, dissolves the metals, the metal, when it undergoes solution, displacing hydrogen. Potassium decomposes the strong acid with explosion.

The anhydrous acid is without action on the majority of metals; potassium and sodium, however, form acid fluorides. It rapidly chars most organic substances, and explodes when mixed with oil of turpentine.

Hydrofluoric acid is usually kept in bottles made of gutta-percha, upon which it exerts no action.

In both the gaseous and fluid form hydrofluoric acid is largely used for etching on glass; and this property constitutes one of its most available and reliable tests. The test may be conveniently applied as follows:

Cover a small piece of window-glass or a watch-glass with a thin layer of wax, scraping away a very small portion by means of a sharply pointed instrument, and then expose the glass for a short time to the vapour of the acid, given off when the materials are heated in a small leaden saucer or platinum crucible; on removing the wax with a little turpentine, the marks on the glass caused by the hydrofluoric acid will be distinctly perceived.

The only important salts of hydrofluoric acid are the fluorides of calcium and ammonium; the former, which is found native as fluor-spar (CaF_2), is used as a flux; the latter is used to expel silicon from its compounds.

HYDROFLUOSILIC'IC ACID. $2HF.SiF_4$. *Syn.* Fluoride of silicon and hydrogen. *Prep.* From powdered fluor-spar and siliceous sand or powdered glass, of each, 1 part; concentrated sulphuric acid, 2 parts; mix in a glass retort, apply a gentle

heat, and pass the evolved gas (fluoride of silicon) into water. In order to prevent the delivery-tube from becoming blocked, it should dip under a little mercury in the bottom of the vessel. Decomposition ensues, silica being deposited in a gelatinous state, and hydrofluosilicic acid remaining in solution. This acid liquor, which is a double fluoride of silicon and hydrogen, is used as a test for barium and potassium, with which it forms nearly insoluble precipitates.

HY'DROGEN. H. *Syn.* HYDROGENIUM, L.; WASSERSTOFF, Ger. An elementary body discovered by Cavendish in 1766. It has been found existing in an uncombined state in the gases evolved from the solfataras of Iceland. Combined with oxygen it constitutes water, and in this form is extensively distributed through earth, air, and ocean. It is an important constituent of all organised tissues.

Prep. Hydrogen is always obtained for experimental purposes by the deoxidation of water by one or other of the following methods:

1. A tube of iron or porcelain (a gun-barrel, for instance) containing a quantity of iron turnings or scraps of iron is fixed across a furnace, so that its middle portion may be made red-hot; to the one end is attached a retort or other vessel containing water, and to the other a bent tube connected with a pneumatic trough or gasometer. The tube being now heated to redness and the water in the retort brought into a state of brisk ebullition, the evolved steam suffers decomposition; the oxygen being absorbed by the iron, and the hydrogen escaping into the gas-receiver.

2. Sulphuric acid (oil of vitriol), diluted with 6 or 8 times its bulk of water, is poured on granulated zinc placed in a retort or gas-bottle; hydrogen is evolved and is collected, as before. Scrap iron may be used instead of zinc, but in this case the mixture must be heated.

Obs. This is the most convenient method of preparing hydrogen, and the one usually adopted in the laboratory. To ensure the gas being quite pure distilled zinc is employed, and the gas is passed, first through a concentrated solution of pure potash, then through a solution of nitrate of silver, and, lastly, through strong oil of vitriol, or over fragments of chloride of calcium. When hydrogen is prepared from crude zinc, it has a slight smell; and when from iron, its odour is often strong and disagreeable.

Prop. Gaseous; colourless; tasteless; odourless (when pure); combustible; sp. gr. ·06935, being 16 times lighter than oxygen gas, and 14·4 times lighter than atmospheric air; 1 litre at 0° C. and 760 mm. pressure weighs 0·894 grm. It is very readily inflamed, even by a red-hot wire, and burns with a scarcely visible flame, forming water. Mixed with atmospheric air or oxygen, it explodes with great violence on the approach of flame, or on sudden compression. One volume of hydrogen and 5 of atmospheric air, and 2 of hydrogen and 1 of oxygen are the proportions that explode with the greatest violence. The combination of hydrogen and oxygen, when mixed, is brought about by the heat of a red-hot solid or a flame, by the electric spark, by the presence of spongy platinum, the black powder of platinum, clean platinum foil, and some other substances. A jet of hydrogen burnt in oxygen gas, or a jet of these gases (mixed) burnt in the air, with proper precautions, produces a most intense heat. Water absorbs about 2% by volume of hydrogen.

Hydrogen has been liquefied and even solidified.

Tests. It is recognised by its combustibility; the pale colour of its flame; producing water only when burnt in air or oxygen; extinguishing the flame of other bodies; and exploding when mixed with half its volume of oxygen and fired.

Uses, &c. Pure and uncombined hydrogen is not employed in the *arts.* Inhalations of this gas have, however, been occasionally used in *medicine.* On speaking immediately after an inhalation, the voice is very shrill and squeaky. Great care should be taken in performing this experiment to inhale only pure hydrogen, as it may contain arseniuretted hydrogen if prepared from impure zinc and acid. Dr Beddoes recommended them in phthisis. In combination, the uses of hydrogen are almost numberless. Combined with oxygen, it forms water; with chlorine, hydrochloric acid; with fluorine, hydrofluoric acid; with cyanogen, hydrocyanic acid; with carbon, innumerable hydrocarbons; with nitrogen, ammonia; with sulphur, sulphuretted hydrogen, and so on.

From its extreme lightness it has been used to fill balloons, but coal-gas is now commonly employed for this purpose. On its property of inflaming in contact with spongy platinum is arranged the little instrument for the production of instantaneous light (DOBEREINER'S LAMP) sold by the philosophical instrument makers. The chemist avails himself of the great heat developed by its combustion in oxygen in the formation of the OXYHYDROGEN BLOWPIPE.

Some of the compounds of hydrogen are noticed *below;* the others under their respective names.

Hydrogen, Antimo''niuretted. SbH_3. *Syn.* HYDRIDE OF ANTIMONY, STIBAMINE; HYDROGENIUM ANTIMONIATUM, L. A gaseous compound of antimony and hydrogen, prepared by dissolving an alloy of antimony with a large excess of zinc in hydrochloric or dilute sulphuric acid. It has never been obtained pure, a variable proportion of free hydrogen being always present. It burns with a bluish-white flame, giving rise to dense fumes of antimony trioxide, and when conducted through a red-hot tube, or the flame is thrown on a cold surface, as a porcelain plate, metallic antimony is deposited. This gas is a deadly poison when inhaled. See ARSENIOUS ACID.

Hydrogen, Arsen'iuretted. AsH_3. *Syn.* HYDRIDE OF ARSENIC, ARSENAMINE; HYDROGENIUM ARSENIURATUM, L. A gaseous compound of arsenic and hydrogen.

Prep. Arsenide of zinc (made by fusing together equal weights of zinc and arsenic) is acted upon by strong hydrochloric acid or by sulphuric acid diluted with 3 parts of water.

Obs. This gas is produced whenever arsenious or arsenic acid, or any of their salts, is in presence of nascent hydrogen. The properties of arseniuretted hydrogen are fully described in the tests for ARSENIOUS ACID. This gas is a deadly poison when inhaled.

Hydrogen, Car'buretted. This term is specially applied to two of the numerous compounds of

carbon and hydrogen (CARBIDES OF HYDROGEN, HYDROCARBONS):

1. **Light Carburetted Hydrogen.** CH_4. *Syn.* MARSH-GAS, FIRE-DAMP. This is often abundantly disengaged in coal mines, and its combustion occasions those fearful explosions which are so destructive to human life. The mud at the bottom of stagnant pools, on being stirred, suffers bubbles of gas to escape, which, when collected and examined, are found to be a mixture of light carburetted hydrogen and carbonic acid. The latter is easily removed by passing the gas through a solution of caustic potash or milk of lime.

Prep. (*Dumas.*) A mixture of acetate of soda (cryst.) and potash (dry), of each, 2 parts, and quicklime (in powder), 3 parts, is strongly heated in a flask or retort. The gas in a state of absolute purity is disengaged in great abundance, and may be collected over water.

Prop. Colourless; neutral; nearly inodorous; burns with a yellow flame, producing pure water and carbonic acid; explodes when kindled in contact with air or oxygen.

2. **Heavy Carburetted Hydrogen.** C_2H_4. See OLEFIANT GAS.

Obs. COAL GAS, OIL GAS, and RESIN GAS consist, for the most part, of mixtures of these two gaseous hydrocarbons in uncertain proportions, obtained respectively from coal, oil, and resin, by the action of heat, and used for the purposes of illumination. See GAS.

Hydrogen, Oxides of. There are two well-defined compounds of hydrogen and oxygen:

1. **Suboxide of Hydrogen.** H_2O. Water (which *see*).

2. **Peroxide of Hydrogen.** H_2O_2. *Syn.* HYDROGEN DIOXIDE; HYDROGENII BINOXYDUM, L. This singular fluid was discovered by M. Thénard in 1818.

Prep. (*Odling.*) A known quantity of pure hydrochloric acid, diluted with 8 or 10 times its volume of distilled water, is placed in a glass beaker surrounded with ice, or a freezing mixture. A quantity of barium dioxide rather less than sufficient to neutralise the acid is then ground to a fine paste with distilled water, and added gradually to the acid, in which it should dissolve without effervescence. Diluted sulphuric acid is next added cautiously, to precipitate the barium, and reproduce hydrochloric acid to act upon a fresh quantity of peroxide. The liquid having been filtered from the insoluble sulphate of baryta, a second proportion of barium dioxide paste is added gradually, as before. The treatment with sulphuric acid, filtration, and addition of dioxide is repeated 6 or 7 times. Sulphate of silver is then very carefully added, so as exactly to precipitate in the form of chloride of silver the whole of the chlorine. After filtration, pure baryta, first as a paste, and then in solution, is cautiously added, to precipitate exactly the sulphuric acid set free from the sulphate of silver. Filtration is again resorted to, and the clear liquid (aqueous solution of peroxide of hydrogen) is placed in a dish over oil of vitriol *in vacuo*, in order that the water mixed with it may evaporate.

Prop., &c. A colourless, transparent, somewhat syrupy liquid, of sp. gr. 1·452. It has a metallic taste, and corrodes the skin. On heating, oxygen is rapidly evolved, and water remains. It mixes freely with water, and becomes more permanent by the dilution. It bleaches organic substances, and acts as a powerful oxidating agent. Under certain circumstances, however, it plays the part of a reducing agent. To the chemist, peroxide of hydrogen and its analogue, dioxide of barium, have been of great service in chemical research. Hydrogen dioxide has been applied in the *arts* to restore the blackened light of paintings which have become darkened by sulphuretted hydrogen; it is also sold by hair-dressers for bleaching human hair.

Hydrogen, Phos'phuretted. See PHOSPHORUS.

Hydrogen, Sulphides of. See SULPHUR.

HYDROMEL. *Syn.* HYDROMELI, L. An aqueous solution of honey. *Prep.* (P. Cod.) Honey, 2 oz.; boiling water, 32 oz.; dissolve, and strain. A refreshing and rather laxative drink; in fevers, hoarseness, sore throats, &c.

HYDROM'ETER. *Syn.* AREOMETER, GRAVIMETER; HYDROMETRUM, L. An instrument for ascertaining the specific gravities of liquids, and hence the strength of solutions, the latter being either in inverse or direct proportion to the former. Hydrometers are of two kinds: 1, those which are always immersed to the same depth in distilled water, and the liquid to be tried, small weights being used for the purpose, as in FAHRENHEIT'S and NICHOLSON'S hydrometers; and 2, those which are suffered to rise or sink freely in the liquid, until they come to a state of rest, as in SYKES', BAUMÉ'S, &c. In both cases a correction must be made for any variation in temperature.

Of the two kinds, the first give the most accurate results, and have the great advantage of being applicable to liquids either lighter or heavier than water; but the second are the readier in practice, requiring less time and less skill to use them. The following are those best known:

BAUMÉ'S HYDROMETER OR AREOMETER, which is very generally employed on the Continent, consists of two distinct instruments, the one for liquids heavier than water, the other for liquids lighter than that fluid. The first floats at the 0, or 'zero,' of the scale, in distilled water, at the temperature of 58° F., and each degree, marked downwards, indicates a density corresponding to 1% of common salt. The hydrometer for liquids lighter than water is poised so that the 0 of the scale is at the bottom of the stem when it is floating in a solution of 1 oz. of common salt in 9 oz. of water, and the depth to which it sinks in distilled water shows 10°; the space between these fixed points being equally divided, and the graduation continued upwards to the top of scale.

The relations and equivalents of Baumé's scales, as now adopted in France, are shown in the following tables.

These instruments were originally adjusted at the temperature of 12½° C., or 54½° F. Those now made in France are adjusted at 15° C., or 59° F.; and those made in England, at 59° or (more usually) 60° Fahr. The standard temperature of the instrument must be known for its correct application.

CARTIER'S HYDROMETER, which is much used in France for light liquids, has the same point for

Corresponding DEGREES *of* BAUMÉ'S HYDROMETERS *and* REAL SPECIFIC GRAVITIES:

1. *Hydrometer for liquids* LIGHTER *than* WATER, or *Pèse-esprit.*

Degrees Baumé.	Specific Gravity.	Degrees Baumé.	Specific Gravity.	Degrees Baumé.	Specific Gravity.
10	1·0000	28	0·8902	45	0·8066
11	0·9932	29	0·8848	46	0·8022
12	0·9865	30	0·8795	47	0·7978
13	0·9799	31	0·8742	48	0·7935
14	0·9733	32	0·8690	49	0·7892
15	0·9669	33	0·8639	50	0·7849
16	0·9605	34	0·8588	51	0·7807
17	0·9542	35	0·8538	52	0·7766
18	0·9480	36	0·8488	53	0·7725
19	0·9420	37	0·8439	54	0·7684
20	0·9359	38	0·8391	55	0·7643
21	0·9300	39	0·8343	56	0·7604
22	0·9241	40	0·8295	57	0·7556
23	0·9183	41	0·8249	58	0·7526
24	0·9125	42	0·8202	59	0·7487
25	0·9068	43	0·8156	60	0·7449
26	0·9012	44	0·8111	61	0·7411
27	0·8957				

2. *Hydrometer for liquids* HEAVIER *than* WATER; *Pèse-acide,* or *Pèse-sirop.*

Degrees Baumé.	Specific Gravity.	Degrees Baumé.	Specific Gravity.	Degrees Baumé.	Specific Gravity.
0	1·0000	26	1·2063	52	1·5200
1	1·0066	27	1·2160	53	1·5353
2	1·0133	28	1·2258	54	1·5510
3	1·0201	29	1·2358	55	1·5671
4	1·0270	30	1·2459	56	1·5833
5	1·0340	31	1·2562	57	1·6000
6	1·0411	32	1·2667	58	1·6170
7	1·0483	33	1·2773	59	1·6344
8	1·0556	34	1·2881	60	1·6522
9	1·0630	35	1·2992	61	1·6705
10	1·0704	36	1·3103	62	1·6889
11	1·0780	37	1·3217	63	1·7079
12	1·0857	38	1·3333	64	1·7273
13	1·0935	39	1·3451	65	1·7471
14	1·1014	40	1·3571	66	1·7674
15	1·1095	41	1·3694	67	1·7882
16	1·1176	42	1·3818	68	1·8095
17	1·1259	43	1·3945	69	1·8313
18	1·1343	44	1·4074	70	1·8537
19	1·1428	45	1·4206	71	1·8765
20	1·1515	46	1·4339	72	1·9000
21	1·1603	47	1·4476	73	1·9241
22	1·1692	48	1·4615	74	1·9487
23	1·1783	49	1·4758	75	1·9740
24	1·1875	50	1·4902	76	2·0000
25	1·1968	51	1·5051		

the zero of its scale as Baumé's, but its degrees are rather smaller, 30° Baumé being equal to 32° Cartier.

FAHRENHEIT'S HYDROMETER consists of a hollow ball, with a counterpoise below, and a very slender stem above, terminating in a small dish. The stem is not graduated, but the middle, or half-length of the stem, is distinguished by a fine line across it. The instrument is immersed in all experiments to the middle of the stem by placing proper weights in the little dish above. Then, as the part immersed is constantly of the same magnitude, and the whole weight of the hydrometer is known, this last weight, added to the weights in the dish, will be equal to the weight of fluid displaced by the instrument; and accordingly the specific gravities for the common form of the tables will be given by the proportion—

As the whole weight of the hydrometer and its load, when adjusted in distilled water, is to the *number* 1000, so is the *whole weight, when adjusted in any other fluid, to the number expressing its specific gravity.*

GAY-LUSSAC'S ALCOHOLOMETER is used to determine the strength of spirituous liquors. It at once indicates on the stem the percentage of absolute alcohol in the liquid examined. The original experiments of Gay-Lussac having been made on liquids at a temperature of 59° F., all examples examined by the alcoholometer must either be brought to that temperature previous to being tested, or a correction made in the strength found.

NICHOLSON'S HYDROMETER is constructed on the same principles as Fahrenheit's. It has in addition to the small dish for weights above, a little cup attached below, for holding any solid body whose weight in water is required. It is chiefly intended for taking the sp. gr. of minerals.

RICHTER'S HYDROMETER resembles, for the most part, Gay-Lussac's.

SYKES' HYDROMETER is that adopted by the Revenue authorities in England for ascertaining the strength of spirits, and has been already fully noticed.

TRALLES'S HYDROMETER resembles Gay-Lussac's.

TWADDELL'S HYDROMETER is much used in the bleaching establishments of Scotland, and in some parts of England. According to this scale, 0 is equal to 1000 or the sp. gr. of distilled water, and each degree is equal to ·005; so that, by multiplying this number by the number of degrees marked on the scale, and adding 1°, the real specific gravity is obtained.

Obs. Hydrometers, unless manufactured with great care and skill, merely afford approximate results, but which are nevertheless sufficiently correct for ordinary purposes. They also require several ounces of liquid to float them, and hence cannot be used for very small quantities. Those of Fahrenheit, Nicholson, and Sykes are the most accurate, both in principle and application. They are all employed with a tall glass cylinder termed a sample, test, or hydrometer glass, in a way already noticed.

ALCOHOLOMETERS, ELAIOMETERS, SACCHAROMETERS, URINOMETERS, &c., are simply hydrometers so weighted and graduated as to adapt them for testing spirits, syrups, urine, &c. See ALCOHOLOMETRY, SPECIFIC GRAVITY, &c.

HYDROM'ETRY. *Syn.* AREOMETRY. The art of determining the specific gravity of liquids, and hence their strength and commercial value. The

instruments used are noticed above; their action depends upon the fact that a floating body displaces a bulk, equal to itself in weight, of the fluid in which it floats, and consequently that a body of a given weight sinks deeper in a lighter than in a heavier fluid. In hydrometric determinations the temperature of the samples must be carefully attended to, for fluids expand as their temperature is increased. The hydrometers used in England are generally adjusted to the standard temperature of 60° F., and when 'Hydrometer Tables,' giving the corrections for the variations of the thermometer, are not accessible, the fluids to be examined should be brought to this standard temperature by applying heat directly to the vessel when the temperature is below the standard, or by surrounding the vessel with cold water when it is above the standard. The principal applications of hydrometry are described in different parts of this work. See ACETIMETRY, ALCOHOLOMETRY, CHLOROMETRY, SPECIFIC GRAVITY, &c.

HYDROP'ATHY. *Syn.* WATER CURE; HYDROPATHIA, L. A mode of curing diseases by the copious use of pure cold water, both internally and externally, together with dry sweating, and the due regulation of diet, exercise, and clothing. This "treatment of diseases undoubtedly includes powerful therapeutic agents, which, in the hands of the educated and honourable practitioner might be most beneficially resorted to as remedial agents" (*Pereira*).

HYDROPHO'BIA. *Syn.* CANINE MADNESS; RABIES CANINA, L. A disease which is generally considered as the result of a morbid poison being introduced into the system by the bite of a rabid animal. See RABIES.

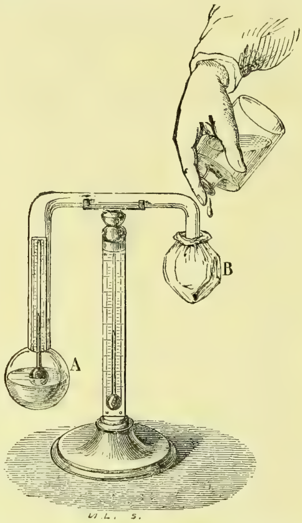
HYDROSULPHU'RIC ACID. See SULPHUR.

HYGIENE. *Syn.* HYGIÈNE, Fr. Health; its preservation, promotion, and restoration. That department of medicine and civil government which relates to health. See AIR, BATH, EXERCISE, FLANNEL, FOOD, NUTRITION, SLEEP, VENTILATION, &c.

HYGROMETER. An instrument for measuring the amount of moisture in the atmosphere. There are various kinds of hygrometers, chemical hygrometers, condensing hygrometers, and psychrometers.

Chemical Hygrometer. This consists of a U-tube containing some hygroscopic substance, as calcium chloride, or pumice-stone soaked in sulphuric acid, and an aspirator by means of which a known volume of air can be drawn through the U-tube. The increase in weight of the U-tube and its contents represents the amount of aqueous vapour in the air.

Daniell's Hygrometer. This is a simple form of condensing hygrometer. It consists of two glass bulbs at the ends of a glass tube bent twice (see *engr.*). The bulb (A) contains some ether into which a delicate thermometer plunges; the rest of the space contains nothing but ether vapour. The bulb (B) is covered with muslin, and ether is dropped upon it; the evaporation cools the bulb (B), and causes the ether vapour inside to condense; the pressure inside the apparatus is thus lowered, and the ether in (A) is caused to evaporate. By this means the bulb (A) is cooled until a film of moisture is noticed on the outside of it; the temperature of the ether is then care-



fully noted. The temperature is also noted at which the film of moisture disappears (on discontinuing the cooling process); the mean of the two temperatures is taken as the dew-point. The temperature of the air at the time of the experiment is indicated by the thermometer on the stem. Having ascertained the dew-point, the *hygrometric state* of the atmosphere may be found: it is the ratio of the vapour-pressure of the aqueous vapour in the air to the vapour-pressure of the aqueous vapour which the air would contain if saturated at the same temperature. This ratio of vapour-pressure is equal to the ratio of the quantity of moisture in the air to the quantity it would contain at the same temperature if saturated.

Regnault's Hygrometer. This is an improved form of Daniell's hygrometer, in which the bulbs are replaced by silver thimbles, and one of them is cooled by aspirating air through ether which it contains.

Psychrometer, or *Wet-bulb Hygrometer.* This consists of two delicate thermometers, of which the bulb of one is kept dry, and that of the other moist. From the difference in the readings of the two thermometers the dew-point can be approximately found.

Hygrometers have also been constructed which depend upon the property of hair, catgut, &c., of elongating when dry, and contracting when moist, but they are by no means accurate. A common form of this kind of hygrometer, or hygroscope, is the chimney ornament consisting of small male and female figures and a little house; the man appears in wet weather, and the woman in fine.

HYOCHO'LIC ACID. $C_{25}H_{40}O_4$. *Syn.* GLYCOHYOCHOLALIC ACID. A compound peculiar to the gall of pigs, discovered by Strecker and Gundelach.

Prep. The fresh gall of pigs is mixed with a solution of sulphate of sodium; the precipitate is

dissolved in absolute alcohol, and decolourised by animal charcoal. From this solution ether throws down hyocholate of sodium, which, on the addition of sulphuric acid, yields hyocholic acid as a resinous mass, which is dissolved in alcohol, reprecipitated by water, and dried. When heated with alkaline solutions, glycocine and a new crystalline acid (hyocholalic acid) are formed. When boiled with acids, it yields glycocine and hyodyslysin.

HYOSCINE. The second alkaloid of hyoscyamus, discovered by Ladenburg. Hyoscine itself is a syrupy body unsuitable for use, but its salts crystallise readily. The hydriodate and hydrobromate are chiefly used; the latter is freely soluble. Hyoscine is a powerful cerebral sedative. Prof. H. C. Wood, Philadelphia, first experimented on this drug. In spermatorrhœa he believes it to have a specific field of usefulness; in erotomania, as an hypnotic where sleep is prevented by too great cerebral activity, and in intense fever with delirium, its influence was also decidedly beneficial. Dr J. Mitchell Bruce finds that it completely controls those conditions of cerebral excitement variously known as delirium, mania, and insomnia, with restlessness; it is a remedy which can be readily administered, and will act immediately, and for several hours so as to afford quiet and rest, not only to the patient, but to those around him.—*Dose*, $\frac{1}{200}$ to $\frac{1}{100}$ gr.

HYOSCY'AMINE. *Syn.* HYOSCYAMIA, HYOSCYAMINA, DATURINE, DATURIA. An alkaloid obtained from common henbane (*Hyoscyamus niger*), and also from the thorn-apple (*Datura stramonium*).

Used as a mydriatic in place of atropine, as an antispasmodic in asthma, epilepsy, whooping-cough, chorea, &c., and subsequently as an hypnotic in cases of insanity. Dr Robert Lawson found it of great value where aggressive and destructive excitement was the leading symptom.—*Dose*, $\frac{1}{120}$ to $\frac{1}{40}$ gr.

HYPNONE. See ACETOPHENONE.

HYPNOT'ICS. *Syn.* HYPNOTICA, L. Agents or medicines which induce sleep, as opium, morphia, henbane, Indian hemp, lactucarium, &c. Agents which prevent sleep are called agrypnotics (*agrypnotica*, L.), or anthypnotics (*anthypnotica*, L.).

HYPOCHLO'RIC ACID. See CHLORINE.

HYPOCHONDRI'ASIS. *Syn.* HYPOCHONDRIACISM. The 'hip' or 'hyp,' the 'vapours,' depression of spirits, 'blue devils.' This disease chiefly affects persons of the melancholic temperament, and is commonly induced by hard study, irregular habits of life, want of proper social intercourse, living in close apartments, and insufficient out-of-door exercise. The treatment may in most cases be similar to that recommended for DYSPEPSIA, observing, however, that success depends more on amusing and engaging the mind, and in gradually weaning it from old conceits, than in the mere administration of medicine. When the patient is tormented with a visionary or exaggerated sense of pain, or of some concealed disease, or a whimsical dislike of certain persons, places, or things, or groundless apprehensions of personal danger or poverty, or the conviction of having experienced some dreadful accident or misfortune, the better way is to avoid any direct attempts to alter his opinions, but to endeavour to inspire confidence in some method of relief. Greding mentions the case of a medical man who conceived that his stomach was full of frogs, which had been successively spawning ever since he had bathed, when a boy, in a pool in which he had perceived some tadpoles; and he had spent his life in endeavouring to get them removed. One patient, perhaps, fancies himself a giant; another as heavy as lead; a third a feather, in continual danger of being blown away by the wind; and a fourth a piece of glass, and is hourly fearful of being broken. Marcellus Dentatus mentions a baker of Ferrara who thought himself a lump of butter, and durst not sit in the sun, or come near the fire, for fear of being melted. The writer of this article once knew a man who always put on his coat the wrong side in front, because he conceived his face looked behind him. In such cases it is useless to argue with the patient, as it only causes irritation, and increases the malady. The restoration of the bodily health, and a sudden surprise or change of scene, will often effect a cure.

HYPONI'TRIC ACID. See NITROGEN.

HYPONI'TROUS ACID. See NITROGEN.

HYPONOMEUTA PADELLA, Tasch. (*Yponomeuta padella*, West.; *Hyponomeuta padellus*, Stainton). The small Ermine Moth. Many apple growers in England, and particularly in Kent, will remember the exceeding destruction caused by this insect in 1865. They will also call to mind how troublesome it was in most of the large apple-producing districts in the year 1877, and in some few places again in 1880, though the last attack was by no means general. Whole orchards were entirely devastated in the two first-named years, so that at the commencement of July the trees were as bare of foliage as in December. Leaves, blossoms, and fruit were all cleared off by the innumerable caterpillars which not only devoured every particle of these, but also actually began to gnaw the most tender portions of the fruit-bearing spurs. Not only did they utterly ruin the crop in these seasons, but they also injured the trees so extensively that they only yielded a small crop in the subsequent seasons.

In 1865, when hundreds of acres of apple orchards had not a leaf or a blossom upon the trees by the action of the caterpillars of this *Hyponomeuta*, many of the oak trees in England were stripped of all foliage by the caterpillars of a kindred species. It was said that these, as well as the apple trees, were 'struck,' or blighted, by the east wind, which had prevailed unusually during the spring.

It is much the fashion to attribute the attacks of insects to the east wind, as if it in some mysterious manner were the actual generator of sundry of the species which spoil the crops and destroy vegetation, or as if they literally came on the wings of the wind. The reason of this is that after a cold and variable spring season, during which there has been an unusual amount of east wind, all kinds of plants, trees, and herbs appear to be more liable to receive injury from insects. This is certainly the case with respect

to hop-plants and to vines, and is due to certain chemical changes and the disorganisation of tissues which render plants more grateful to the tastes or more suitable to the constitution of parasites. Dr Sachs, in his 'Physiology of Vegetation,' and De Candolle ('Physiologie Végétale, Influence des Agens Extérieurs,' par A. De Candolle) have shown that plants are materially affected by sudden changes of temperature, and by radiation, which is especially intense in clear cold mornings. And in these circumstances it is pretty certain that the wind has been in the east, which is 'neither good for man nor beast;' nor for plant, may be well added.

Passing through Brittany and Normandy in 1865, it was seen that the trees in most of the apple orchards had been attacked in the same manner as those in England by the *Hyponomeuta*. The oak trees in many of the French forests were also rapidly losing their foliage in June in the same year from the action of caterpillars, and even in the Bois de Boulogne many of the trees were completely bare of leaves. An eminent pomologist in the central part of France writes that in 1865 the *Hyponomeuta* caused great losses to apple growers, and that twice since that date it has sadly injured the crop of apples.

There is no record that this insect is known in America and Canada. In Germany it is very destructive, though from the descriptions of Schmidberger and Taschenberg there is some doubt as to whether the German species is quite identical with the English.

Some confusion exists also among English entomologists as to the species in this country which attack apple trees. It is said by some that the *Hyponomeuta cognatella* is the real offender. Others that the *Hyponomeuta malivosella*, or *malinella*, alone occasions the mischief. But no one who has seen the larvæ actually upon the leaves, and noted the colour and markings of the wings of the moth, can doubt that it is the *Hyponomeuta padella* which is the veritable cause of the evil.

The common hawthorn is also frequently assailed by the *Hyponomeuta padella*. It is by no means unusual to see the hedges—'quick' hedges—entirely bare of leaves, and the twigs covered with webs either full of caterpillars or deserted by the hosts whose food has become exhausted.

Life History. The *Hyponomeuta padella* belongs to the family *Hyponomeutidæ* of the Nat. Ord. LEPIDOPTERA. Westwood places this family between the *Tortricidæ* and the *Tineidæ*. Mr Stainton, splitting up the division *Heterocera* into nine groups, places the *Hyponomeutidæ* in the seventh group, *Tineina*.

The perfect insect is about 8 lines across its expanded wings, and its body is a little more than 5 lines in length—that is, rather more than the third of an inch. Its anterior or fore-wings are white, having a tinge of ash-grey more prominent in some specimens than in others. Upon these wings there are irregular rows of black dots. In this respect it differs from the species *Hyponomeuta cognatella* with which it is frequently confounded, upon whose wings the dots are more regularly placed in rows. The wings of *H. cognatella* also are generally white. The posterior or hind-wings of *H. padella* are of a darker grey than the fore-wings, with very pale grey, almost white, cilia, or fringes.

About the first week in July the moth, which is quiescent in the daytime, and flies in the twilight, lays from 20 to 30 eggs upon the small spurs of the apple trees near to the bases of the leaves. These may be found in little groups or heaps, firmly fastened together and to the spurs with a glutinous substance to keep them in their places, as well as to serve as a protection. After a while, depending in a degree upon the weather and other conditions, but generally before the leaves have fallen, tiny caterpillars are hatched from the eggs. They remain very small and keep close together in groups under the shelter of their viscous covering until the spring comes, and the leaves begin to appear. At first the little caterpillars are only about the 24th part of an inch long. Their colour is dirty white or yellowish, and they have dark heads. Directly the leaves and blossoms show signs of bursting forth the caterpillars leave their nest and get into the nascent leaf-whorls and the developing calyces of the blossoms, and commence feeding at once upon these. Professor Westwood is of opinion that they first burrow into the tissues of the leaves and feed upon these under the parenchyma. I have not been able to discover this, though it is by no means unlikely, but I have found them in the whorls and in the calyces, evidently feeding upon their external structure. When they get larger, and the foliage and the flowers are fully out, they congregate together and spin webs round the leaves and the clusters of leaves and flowers, either to mark them thus for their own, or to protect themselves from the weather. At full size they are rather more than 3-4ths of an inch in length, of a dark grey or lead colour, having 16 feet. They assume the pupa stage in due time, or when the food-supply runs short, and each caterpillar enwraps itself in a cocoon within the area of the general web. As a rule the moths appear towards the end of June. I have observed also that within two or three days a general transformation has taken place and that the webs are forsaken, while in the evening the air is full of little moths hovering round the branches, preparing to deposit eggs to perpetuate their species for another season.

Prevention. After an attack, especially if the groups of little caterpillars are found upon the spurs—and it must be said here that it requires very good eyes and close inspection to discover them—lime may be thrown up over the trees, which would at all events dislodge some of them. This operation must be carefully and thoroughly carried out. Solutions of soft soap and water, in the proportions of 12 lbs. of soft soap and 5 lbs. of quassia to 100 galls. of water, may be applied with much advantage in the autumn to infested trees, half-standards, pyramids, espaliers, bushes, and small standards. It would be tedious and costly to wash full-sized apple trees in orchards, but it would pay without doubt if from the presence of the caterpillars in numbers a

severe attack might be expected in the ensuing spring.

It has been noticed occasionally that the hawthorn hedges around apple orchards are infested with these caterpillars, whose webs completely cover the leaves and twigs. To prevent these from changing into moths it would be desirable to beat the hedges well on both sides and to trample upon the caterpillars, or to dig them into the ground if the hedge-sides are dug, as is generally the case in Kent, where the quick hedges are well kept, being in many cases dug twice and brushed twice in the year.

Remedies. It is most difficult to apply remedies in large orchards and upon large trees. When the caterpillars commence operations they are protected by the leaves and blossoms. Afterwards they are covered by their webs, which would serve to shield them from applications of soft soap and quassia.

In the case of low trees and bushes the webs may be brushed off the trees and the caterpillars dug into the ground with lime, or trampled upon. Or copious washings with soft soap and quassia may be tried.

Starlings are great devourers of these caterpillars. They build in the holes in old apple trees, and effectually keep those near their nesting-places clear from insects ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

HYPOPHOSPHOROUS ACID. See PHOSPHORUS.

HYPOSULPHU'RIC ACID. *Syn.* DITHIONIC ACID. $H_2S_2O_6$. The barium salt can be prepared by passing sulphur dioxide through water containing manganese dioxide in suspension.

HYPOSUL'PHUROUS ACID. See SULPHUROUS ACID.

HYRA'CEUM. A substance produced by the Cape badger (*Hyrax capensis*), and proposed as a substitute for CASTOREUM. Pereira considered it to be inert and useless.

HYSTERICS. *Syn.* HYSTERIA, PASSIO HYSTERICA, L. In *pathology*, a nervous affection peculiar to women, attacking in paroxysms or fits, preceded by dejection, tears, difficult breathing, sickness, and palpitation of the heart. The treatment of this disease varies with the causes and the symptoms. Bleeding, cupping, and depletives are generally had recourse to in robust and plethoric habits, and stimulants and tonics in those of a weakly or relaxed constitution. Affusion of cold water and nasal stimulants will frequently remove the fit in mild cases. Exercise, proper amusements, and regular hours and diet, with constant occupation, are the best preventives. See DRAUGHT (Antihysteric and Hydrocyanic), &c.

ICE. *Syn.* GLACIES, L. Water in the solid state. On being cooled water gradually contracts until the temperature has fallen to 32·9° F., when it begins to expand. At the freezing-point, 32° F., under ordinary conditions, water crystallises or freezes, and in consequence of the continued expansion the sp. gr. of ice, as compared with that of water at 39·9°, is as ·94 to 1·00. Ice has the peculiar property of reuniting by the contact of adjoining surfaces after having been broken into fragments (REGELATION). Coloured water and salt water, by freezing, produce colourless and fresh ice; and clean solid ice, when thawed, furnishes water equal in purity to that which has been distilled.

The use of ice in the preparation of ICE-CREAMS, ICED LIQUORS, &c., is noticed elsewhere. The confectioner collects his ice as early as possible during the winter, and stores it in a well-drained well or excavation, somewhat of the form of an inverted sugar-loaf, contained in a small shed or building called an ICE-HOUSE. This building should always be situated on a dry sandy soil, and, if possible, on an eminence. The door should be on the north side, and the roof should be conical and thickly thatched with straw.

In *medicine*, ice is frequently employed externally in inflammation of the brain, to resolve inflammation, to stop hæmorrhage, to constringe relaxed parts, and as an anodyne to deaden pain. For these purposes it is pounded small in a cloth, and placed in a bladder or bag of gauze (ICE-CAP, ICE-POULTICE) before applying it. Internally, ice or ice-cold water has been given with advantage in heartburn, typhus, inflammation and spasms of the stomach, to check the vomiting in cholera, and to arrest hæmorrhage, whether bronchial, gastric, nasal, or uterine. Very recently ice has been proposed as a remedy in the treatment of diphtheria. Small lumps of ice, or a small glassful of pounded ice-and-water, will often temporarily restore the tone of the stomach and nervous system during hot weather, when all other means fail. Ice-creams, taken in moderation, act in the same way.

In the warmer climates of Europe an ICE-HOUSE or an ICE-SAFE (a REFRIGERATOR) is a necessary appendage to every respectable dwelling, not merely for the purpose of pleasing the palate with iced beverages, but to enable the residents to preserve their provisions (fish, meat, game, milk, butter, &c.) in a wholesome state from day to day. In addition to large cargoes of ice imported yearly from Norway, and principally consumed in England, Germany, and France, ice is now manufactured to no inconsiderable amount in these three countries artificially, the principal consumption of the factitious article being by brewers, who use it for the cooling of their worts. The artificial manufacture of ice is effected by means of the condensation of elastic vapours in machines expressly made for the purpose. In Siebe's ice-making machine the vapour of ether is made to traverse metallic tubes surrounded with a concentrated solution of common salt, by which it becomes recondensed to the liquid state, to be again utilised in the production of the vapour, the solution of salt becoming at the same time so reduced in temperature as to convert into ice water contained in proper vessels placed in it. In Carré's machine the same end is accomplished by means of ammoniacal gas, a solution of calcic chloride being used for absorbing the cold instead of common salt. Reece's is a modification (he states an improvement) of Carré's. Ice machines are also made in which ice is produced by bringing water into contact with air which has been greatly reduced in temperature by cooling it when in the compressed state, and subsequently allowing

it to expand. Liquid carbonic and sulphurous acids have likewise been used in the preparation of artificial ice, but not when it has been required in any considerable quantity. See REFRIGERATION.

Ice, Medicated. Mr Martin, of Weston-super-Mare, writing to the 'Lancet,' says:—"Every practitioner has at times to face the difficulties of the scarlatinal throat in young children. It may sadly want topical medication; but how is he to apply it? Young children cannot gargle, and to attempt the brush or the spray fills them with terror. In many cases neither sternness nor coaxing avails. Yet these little ones, in almost every case, will greedily suck bits of ice. This has long been my chief resource where I could not persuade the child to submit to the sulphurous acid spray. Lately I have been trying an ice formed of the frozen solution of the acid (or some other antiseptic). Though, of course, not so tasteless as pure ice, the flavour is so much lessened by the low temperature, and probably also through the parched tongue very little appreciating any flavour, that I find scarcely any complaint on that score from the little sufferers; they generally take to it very readily. The process of making it is very simple. A large test-tube immersed in a mixture of ice and salt is the only apparatus required, and in this the solution is easily frozen. When quite solid a momentary dip of the tube in hot water enables one to turn out the cylinder of ice as the cook turns out her mould of jelly. I have tried the three following formulæ, all of which answer, although I think I prefer the first.

"1. Sulphurous acid, ½ dr.; water, 7½ dr.; mix and freeze.

"2. Chlorate of potass, 1 scr.; water, 1 oz.; dissolve and freeze.

"3. Solution of chlorinated soda, ½ dr.; water, 1 oz.; mix and freeze.

"However, the form is of secondary importance, as each practitioner can construct his own. Boracic acid, salicylic acid, or any other harmless antiseptic with not too much taste, would doubtless be as useful as those indicated."

ICE'LAND MOSS. *Syn.* CETRARIA (B. P.), LICHEN ISLANDICUS, L. The lichen termed *Cetraria islandicus.* It is much employed, both as a nutritious food and as a mild mucilaginous tonic, in catarrh and consumption. It may be purified from its bitter principle by a little cold solution of potassa.

Iceland Moss, Saccharated. *Syn.* (P. C.) SACCHARUM LICHENIS. Iceland moss, 1 lb.; refined sugar, 1 lb.; macerate the moss in water to extract the bitterness; express, boil in water for an hour; strain, let settle, decant, add the sugar; evaporate to dryness with a gentle heat, constantly stirring, and finally reduce to powder.

ICELAND SPAR. Native calcium carbonate. See CALCIUM.

ICES. (In *confectionery.*) These are commonly composed of cream or sweetened water, variously flavoured, and congealed by ice or a freezing mixture. Sometimes, instead of cream, the materials of a custard are used. The mixed ingredients are placed in a tin furnished with a handle at top, called a 'freezer,' or 'freezing-pot,' which is then plunged into a bucket containing ice broken small, and mixed with about ½ its weight of common salt, and is kept in rapid motion, backwards and forwards, until its contents are frozen. As the cream congeals and adheres to the sides, it is broken down with the ice-spoon, so that the whole may be equally exposed to the cold. As the salt and ice in the tub melt, more is added, until the process is finished. The 'ice-pot,' with the cream in it, is next placed in a leaden 'ice-stand,' is at once surrounded with a mixture of ice and salt, and closely covered over. In this state it is carried into the shop. The glasses are filled as required for immediate use, and should have been previously made as cold as possible.

PLAIN ICE-CREAM, or CREAM FOR ICING, is commonly made by one or other of the following formulæ:

1. New milk, 2 pints; yelks of 6 eggs; white sugar, 4 oz.; mix, strain, heat gently and cool gradually.

2. Cream, 1 pint; sugar, 4 oz.; mix as above.

3. Cream and milk, of each, 1 pint; white sugar, ½ lb.

FLAVOURED ICE-CREAMS are made by mixing cream for icing with ½ its weight of mashed or preserved fruit, previously rubbed through a clean hair-sieve; or, when the flavour depends on the juice of fruit or on essential oil, by adding a sufficient quantity of such substances. RASPBERRY and STRAWBERRY ICES are made according to the former method; LEMON, ORANGE, NOYEAU, and ALMOND ICES, by the latter method. In the same way any other article besides cream may be frozen.

CHOCOLATE FOR ICING is made by rubbing 1 oz. of chocolate to a paste with a table-spoonful of hot milk, and then adding 'cream for icing,' 1 pint.

COFFEE FOR ICING is made of cream for icing, 1 quart, to which a small teacupful of the strongest possible clarified coffee has been added together with 2 oz. of sugar and the yelks of 3 or 4 eggs. See ICING (*below*).

ICHTHYOL (Sulpho-ichthyolate of Sodium). A bituminous substance containing a large amount of sulphur is obtained by treating the products of distillation of a bituminous quartz found in the Tyrol with sulphuric acid and neutralising with ammonia. It has been used with great success in rheumatic affections, eczema, &c. A 10% ointment applied to the joints in acute rheumatism, wrapping up the parts in wadding, is said to give immediate relief. In chronic rheumatism, lumbago, and neuralgia, a 20% to 30% ointment has been employed. In the early stages of gonorrhœa and in eczema it is very highly spoken of.—*Dose,* 10 to 30 gr. a day.

I'CING. (For cakes.) *Syn.* SUGAR ICE. The covering of concreted sugar with which the confectioners adorn their cakes.—*Prep.* Beat the white of eggs to a full froth, with a little rose or orange-flower water; then add gradually as much finely powdered sugar as will make it thick enough, beating it well all the time. For use, dust the cakes over with flour, then gently rub it off, lay on the icing with a flat knife, stick on the ornaments while it is wet, and place it in the oven for a few minutes to harden,

but not long enough to discolour it. It may be tinged of various shades by the addition of the proper 'stains.'

ID'RIALIN. $C_{40}H_{28}O$. A fusible, inflammable substance, found associated with the native cinnabar of the mines of Idria, in Carniola. It is extracted from the ore by means of oil of turpentine. It is only slightly soluble in alcohol and ether. When pure, it is white and crystalline.

ID'RYL. *Syn.* FLUORANTHENE. $C_{15}O_{10}$. Obtained from coal-tar; it distils over above 360° C., forming a part of the crude phenanthrene. It crystallises from alcohol in needles or plates.

IGNI''TION. In the *laboratory*, this term is commonly applied to the act of heating to redness or luminousness. See CALCINATION.

ILLICIN. Boil a clear decoction of holly with animal charcoal; let it settle, collect the deposited charcoal, wash it with cold water, dry it, and treat it with boiling alcohol; let the filtered liquid be evaporated to dryness. Febrifuge.—*Dose,* 6 to 24 gr.

ILLUMINA'TION. The act of illuminating or making luminous. For supplying artificial light to streets and the interiors of houses coal-gas and oils and fats are generally employed. These illuminating agents are compounds rich in carbon, upon the presence of which the brightness of their flames depends. Flame is gas or vapour heated to incandescence during the process of combustion. A flame containing no solid particles emits but a feeble light, even if its temperature is the highest possible. Pure hydrogen, for instance, burns with a pale, smokeless flame, though with the production of considerable heat. On the other hand, wax, paraffin, coal-gas, &c., while undergoing combustion, give out considerable light, because their flames contain innumerable solid particles of carbon, which act as radiant points. To give the greatest degree of luminosity to flame, the supply of air must be proportioned to the character of the burning substance, and be insufficient for the instantaneous combustion of the evolved gases; in which case the hydrogen takes all the oxygen, and the larger portion of the carbon is precipitated and burnt in the solid form, at some little distance within the outer surface of the flame. When the supply of air is sufficient for the immediate and complete combustion of the whole of the combustible matter, no such precipitation takes place, and the flame is neither white nor brilliant. The richest coal-gas, mixed with sufficient air to convert all its hydrogen and carbon into water and carbonic acid, explodes with a pale blue flash; yet the same gas, when consumed in the ordinary way, burns with a rich white flame. Every one must have noticed the effect of a gust of wind upon the flaring gas-jets of a butcher's shop; the plentiful supply of air causes complete combustion, and so converts the bright white flames into dull blue streaks of fire. When the supply of air is insufficient to cause the combustion of the newly formed solid carbon at the instant of its development, and whilst it is in an incandescent state, the flame becomes red and smoky, and unburnt sooty particles are thrown off. The same occurs when the temperature of any portion of the hydrogen is reduced below that intensity required for the combustion of the newly separated charcoal. Solid bodies, as tallow, oils, and fats, which burn with flame, are converted into the state of gas by the heat required to kindle them, and it is this gaseous matter which suffers combustion, and not the substance which produces it.

The relative value of the ordinary illuminating agents has been accurately determined by Dr Frankland. According to his experiments, the quantities of various substances required to give the same amount of light as would be obtained from 1 gall. of Young's paraffin oil are as follows:

Young's paraffin oil	1·00 gall.
American rock oil (acknowledged to be an inferior sample)	1·26 ,,
Paraffin candles	18·6 lbs.
Sperm	22·9 ,,
Wax	26·4 ,,
Stearic	27·6 ,,
Composite	29·5 ,,
Tallow	39·0 ,,

The following table exhibits the comparative cost of the light of 20 sperm candles, each burning 10 hours at the rate of 120 gr. per hour; also the amount of carbonic acid produced and heat evolved per hour in obtaining this quantity of light:

	Cost. s.	d.	Carb. acid per hour in cubic feet.	Units of heat per hour.
Wax	7	2½	8·3	82
Spermaceti	6	8		
Paraffin candles	3	10	6·7	66
Tallow	2	8	10·1	100
Rock oil	0	7½	3·0	29
Paraffin oil	0	6		
Coal-gas	0	4½	5·0	47
Cannel-gas	0	3	4·0	32

These figures prove that coal-gas and the mineral oils are the cheapest and best illuminating agents, producing the largest amount of light with the least development of heat.

The light emitted by incandescent lime (DRUMMOND LIGHT, HYDRO-OXYGEN LIGHT, LIME-LIGHT, OXYHYDROGEN LIGHT) is intensely brilliant, and is often made use of to enable workmen to continue operations at night. It is obtained by directing the flame produced by the combustion of a mixture of hydrogen (or coal-gas) and oxygen upon a small cylinder of lime. In the improved form of this light the lime is protected from crumbling by a cage of platinum wire, and is caused to rotate slowly by means of clockwork, so as constantly to expose a fresh surface to the flame. When reflected from a 'parabolic mirror' in a pencil of parallel rays, the Drummond light has been recognised during daylight at a distance of 108 miles. The lime-light produced with coal-gas and oxygen is used for the MAGIC LANTERN and GAS MICROSCOPE.

The most powerful illuminator is the ELECTRIC LIGHT, which is now being subjected to trial in many cities for street illuminations, &c., in place of coal-gas. It is usually produced by the passage of a strong current of electricity between two pencils of hard carbon. The electric light has been successfully applied to lighthouse illumina-

tion. Hitherto it has been found too intense and too costly for application to domestic purposes. See CANDLES, FLAME, GAS, PHOTOMETRY, &c.

ILLUTA'TION. See BATH (Mud).

IMAGINA'TION. The influence of the imagination, both in the production and cure of disease, has been long admitted by medical practitioners. It is probably the most powerful therapeutic agent known. "Extraordinary cures have been ascribed to inert and useless means, when, in fact, they were referable to the influence of the imagination" (*Dr Pereira*).

IMPE'RIAL. *Syn.* POTUS IMPERIALIS, PTISANA I., L. *Prep.* 1. Cream of tartar, ¼ oz.; 1 lemon, sliced; lump sugar, 2 oz.; boiling water, 1 quart; infuse, with occasional stirring until cold, then pour off the clear portion for use.

2. A lemon, sliced; sugar, 1 oz.; boiling water, 1 pint.

3. Yellow rind and juice of lemon; citric acid, 1 dr.; sugar, 2½ oz.; hot water (which has been boiled), 1 quart; as No. 1. Refrigerant and slightly diuretic. Used as a common drink in fevers, dropsy, &c., and as a summer beverage.

IMPROV'ING. The trade name for 'doctoring,' 'adulterating,' or 'lowering' the quality of any substance, with the view of cheapening it or increasing its bulk. See WINE, &c.

IN'CENSE. *Prep.* 1. Olibanum, 2 or 3 parts; gum-benzoin, 1 part.

2. Olibanum, 7 parts; gum-benzoin, 2 parts; cascarilla, 1 part. Placed on a hot plate or burned, it exhales an agreeable perfume. Used in some of the rituals of the Roman Catholic Church.

3. Benzoin and storax, of each, 4 oz.; laudanum and myrrh, of each, 6 oz.; cascarilla, 3 oz.; oil cinnamon, 8 minims; oils bergamot and lavender, of each, 20 minims; oil cloves, 10 minims; mix, and pass through a coarse sieve.

INCINERA'TION. The reduction of organic substances to ashes by combustion. See CALCINATION.

INCOMBUSTIBIL'ITY. The property of being incapable of being kindled, or of being consumed by fire. Substances possessing this property are said to be 'incombustible' or 'fire-proof.'

INCOMBUSTIBLE FABRICS. Muslin and other light fabrics may be rendered incombustible by steeping them in certain saline solutions. Thus, cotton or linen stuffs prepared with a solution of borax, phosphate of soda, phosphate of ammonia, alum, or sal-ammoniac, may be placed in contact with ignited bodies without their suffering active combustion or bursting into flame. The salts act by forming a crust of incombustible matter on the surface of the fibres. They do not, however, prevent carbonisation taking place when the temperature is sufficiently high. It is by a knowledge of this property of culinary salt that jugglers are enabled to perform the common trick of burning a thread of cotton while supporting a ring or a small key, without the latter falling to the ground. The cotton is reduced to a cinder, but from the action of the salt its fibres still retain sufficient tenacity to support a light weight.

The addition of about 1 oz. of alum or sal-ammoniac to the last water used to rinse a lady's dress, or a set of bed furniture, or a less quantity added to the starch used to stiffen them, renders them uninflammable, or at least so little combustible that they will not readily take fire; and if kindled, are slowly consumed without flame. None of the above-named salts are adapted for fine soft muslins, which mostly require chemical treatment, because they injure the texture, rendering the fabric harsh, and destroying all its beauty. The salt which is found to answer most completely all the required conditions is TUNGSTATE OF SODA. "Muslin steeped in a solution containing 20% of this salt is perfectly non-inflammable when dry, and the saline film left on the surface is smooth and of a fatty appearance like talc, and therefore does not interfere with the process of ironing, but allows the hot iron to pass smoothly over the surface. The non-fulfilment of this latter condition completely prevents the use of many other salts—such as sulphate or phosphate of ammonia, which are otherwise efficacious in destroying inflammability—for all fabrics which have to be washed and ironed" (*Watts*).

The addition of a little phosphoric acid or phosphate of soda to the tungstate is recommended, for without this addition a portion of the tungstate is apt to undergo a chemical change and become comparatively insoluble. Messrs Versmann and Oppenheim, the introducers of tungstate of soda, give the following formula for a solution of minimum strength:

Dilute a concentrated solution of neutral tungstate of soda with water to 28° Tw. (sp. gr. 1·14), and then add 3% of phosphate of soda. This solution is found to keep and to answer its purpose very well; it is now constantly used in the Royal Laundry.

PAPER, WOOD, &c., may be also rendered comparatively incombustible by soaking them in saline solutions. See ASBESTOS, FIRE, &c.

INCOMPAT'IBLES. In *medicine* and *pharmacy*, substances which do not agree with each other, and cannot, therefore, with propriety, be prescribed together in the same formula or prescription. Incompatibility is of three kinds: 1, chemical; 2, physical; 3, therapeutic. The principles on which we should act to avoid prescribing or dispensing incompatibles are briefly developed under the heads AFFINITY and DECOMPOSITION. To this we may add that, if a substance is endowed with well-marked therapeutical or poisonous properties, independent of those which may exert a chemical effect upon the tissues, its mode of action will neither be changed nor destroyed by the combinations which it forms, provided always that the new compounds are not insoluble in water.

"It is not necessary to give two incompatible medicines at the same time, in order to produce decomposition; it is sufficient if they are given within a very short interval of each other. Thus, a sick person, who has been treated with lead externally, or even internally, will present a discoloration of the skin if he takes a sulphur-bath 4 or 5 days after the lead treatment has been discontinued. If a person is rubbed with iodide of potassium shortly after having applied Vigo's plaster (plaster of ammoniacum with mercury),

or the Neapolitan ointment (mercurial ointment), iodide of mercury and caustic potash will be formed, which will cause vesication. So also vomiting occurs if lemonade made with tartaric acid is taken 5 or 6 days after the administration of white oxide of antimony" (*Trousseau* and *Reveil*).

Lists of incompatibles are published in many pharmaceutical and medical works, but are, in reality, of little use beyond illustrating rules and principles which are familiar to every chemist, and which every prescriber should also be intimately acquainted with.

INCRUSTATION, Prevention of, in Steam Boilers. With all qualities of water commonly used for feeding steam boilers there is a tendency to the production of hard calcareous deposits or layers of incrustation within the boilers, due to the separation of lime salts (particularly the carbonate and sulphate, or mixtures of these with a certain amount of carbonate of magnesia) as the direct consequence of the accumulation of these impurities from large quantities of water evaporated. The sparing solubility of the sulphate of lime (gypsum) in hot water fully accounts for its deposition in the boiler, and the carbonate of lime (chalk) is thrown down, not only as the result of direct evaporation, but by the ebullition expelling free carbonic acid, which holds this body to some extent in solution. Rain water, which of itself is too pure to give rise to these incrustations, cannot be used *alone* for boiler purposes, for it has been found to exert a highly corrosive action upon the iron plates and fittings. It can, however, be advantageously employed in conjunction with 'hard' spring or river waters, and has the effect of diminishing the incrustation merely as the result of dilution. The drain-pipes leading from the roof of the factory may be placed in connection with the tank or well from which the supply of water is drawn for the boilers. It will be seen hereafter that the selfsame remedy is efficient both as a means of preventing incrustation and obviating corrosion, and that by using one of the alkaline substances about to be specified this twofold advantage may be secured. Iron will not rust when immersed in water containing a mere trace of caustic alkali, and it is a common observation that the iron vessels used in the preparation of potash and soda remain for any length of time free from all appearance of rust. This singular property is, no doubt, susceptible of important applications; amongst them may be mentioned the better protection of iron ships from the attack of bilge-water, of hydraulic rams, moulding boxes, smith's tools, and other objects liable to be placed at times under the influence of water. Some forms of surface condensers become quickly corroded in consequence of the purity of the water accumulating in them by the process of distillation, and a small dose of caustic alkali is then useful as a means of protection. The engine-cylinders also to some extent are preserved when alkaline anti-incrustation fluids are introduced into the boilers, for the minute quantity which is carried forward mechanically in the form of spray, mixed with the steam, suffices to preserve the iron. Whilst a tendency to 'priming' undoubtedly results from a too liberal use of soda or other alkali in the boiler, it will in practice be found easy to adjust the proportion of this ingredient so as to secure immunity from corrosion and incrustation, and at the same time avoid the tumultuous kind of ebullition known as 'priming.' In all cases it is advisable to carry out a rigid system of inspection, and it is only in the way of saving fuel and labour that the application of boiler fluids is to be recommended.

Much benefit has often resulted from a coating of coal-tar or 'dead oil' applied to the interior surfaces below the water-line, when the boiler is opened for cleaning and inspection. These will tend very considerably to lessen the adhesion of calcareous crusts, and are not in any way affected by the boiler fluids in common use. Soda crystals and caustic soda may be used with great success in boilers to effect the immediate precipitation of the lime salts, and they act by throwing down a finely divided form of carbonate of lime, which in time furnishes nuclei for the deposition of subsequent accretions both of the carbonate and sulphate, so that they are prevented from crystallising upon the walls of the boiler. A granular mud is thus formed, which subsides quickly and may be for the most part got rid of through the 'blow-off cock,' which should be opened for this purpose 2 or 3 times every day, and run out with as little water as possible.

The use of caustic soda has undergone a thorough trial at the hands of Mr J. Spiller, F.C.S., in the boilers of the Royal Arsenal, Woolwich, and we are favoured with the following general instructions regarding its use, which are based upon an experience of upwards of 10 years. The caustic soda should be dissolved in water so as to make a concentrated solution of sp. gr. 1·300. This, being perfectly miscible with water, may be introduced into the boiler with the feed-water at any time when, from the pressure of steam, it may not be convenient to pour it through the safety-valve or other openings in the boiler. But when the steam is down there is no difficulty in introducing the prescribed dose by using a tin funnel with flattened aperture to pass it through the safety-valve; or a tubular arrangement with double cocks will answer at all times. ½ gall. per diem is the average quantity found sufficient for a 20-horse stationary boiler, working with Thames water for 10 hours daily. If the water should happen to be unusually hard a larger dose may be employed, but it would not be expedient to add in one charge more than the amount required for the day's consumption. Locomotive and multitubular boilers have been worked successfully with caustic soda, and it is here that the importance of using anti-incrustation fluids makes itself most apparent.

Many other methods have at various times been proposed to prevent the formation of deposits in steam boilers. Dr Ritterband's method consists in simply throwing a little sal-ammoniac into the boiler, by which carbonate of ammonia is formed, which passes off with the steam, and chloride of calcium, which remains in solution. In Holland this plan has been used with satisfaction for locomotive boilers. About 2 oz. of the salt may be placed in the boiler twice a week. The chloride of tin is equal to sal-ammoniac, and is similar in

its action. Carbonate of soda has been recommended by Kuhlmann and Fresenius of Germany, and by Crace Calvert of England. It is now employed generally in the boilers of engines in Manchester. The common plan adopted by working engineers to prevent incrustations from either variety of water is, on each occasion of cleaning out the boiler, to introduce some substance which, by its mechanical action, shall prevent the precipitated earthy matter caking together, or adhering to the boiler plates. Some common tar, bitumen, or pitch appears to answer well under most circumstances. Mr Ira Hill recommends the use of 3 or 4 shovelfuls of coarse sawdust. He states that, after adopting the use of this article, he never had any difficulty from lime, although using water strongly impregnated with it, and has always found the inside of his boilers as smooth as if just oiled. Mr De Haen recommends the sulphate and bicarbonate of calcium to be decomposed by adding barium chloride and milk of lime in the proper proportion; when the water is at a temperature of 35°—45° C. the whole becomes clear in about 10 minutes, and a precipitate consisting of a mixture of barium sulphate and calcium carbonate deposits. If the water be cold, the greater part separates in 10 minutes, but a little turbidity is noticeable for some hours due to suspended matter.

Protzen recommends the introduction of a piece of zinc into the boiler; this determines a galvanic current, which protects the iron against oxidation and corrosion, and causes the mineral ingredients of the water to be deposited as a fine loose mud, entirely preventing the formation of incrustation.

Slippery elm bark, and spent bark from the tan-works have also been suggested. We (A. J. Cooley) have worked a powerful boiler daily for months without opening the 'man-hole,' after throwing a few pounds of potatoes into it. In all cases, when the earthy matter can be kept in a state of solution, or precipitated in a pulverulent form, it is easily removed from the boiler by what engineers term 'priming,' which is allowing the hot water to be blown over with the steam, so that, after a sufficient time, the whole original contents of the boiler are removed, and replaced by fresh water. Before doing so, however, it is of consequence to cut off the communication with the cylinders, and to open the waste-steam cock. Consult a pamphlet on 'Boiler Incrustation and Corrosion,' by F. J. Rowan, published by Spon, London.

INCUBATION (Artificial). The hatching of eggs by artificial heat. This has been practised by the Egyptians from a very remote period. M. Bonnemain has the honour of having introduced this art to Western Europe in 1775, and having been the first to pursue it successfully on the commercial scale. The source of heat employed by him was a circulatory hot-water apparatus, and the temperature maintained by it 100° F. His plan was to introduce, daily, 1-20th only of the eggs the apparatus was capable of receiving, so that on the 21st day the first chickens were hatched, and a like number every day afterwards as long as the supply of eggs was kept up. Among the trays containing the eggs he placed saucers of water, to compensate for the absence of moisture derived in natural incubation by transpiration from the body of the hen. The chickens, as soon as hatched, were transferred to a 'nursery' or 'chick-room,' also artificially heated, and were fed with crushed millet-seed. The hatching of eggs by artificial heat has in recent years passed out of the stage of experiment and become a matter of business. Many forms of apparatus are in the market, and there is, perhaps, little to be said for or against any of them, as, if properly managed and attended to, all answer the purpose for which they are intended. One of the best is Hearson's Incubator, figured on the next page.

The *engr.* is a vertical section of the incubator from left to right, and shows how it would appear if cut through in a line with the lamp-burner.

The upper half of the box contains a tank of water (A A), through which a pipe or flue (L L) passes from one side to the other. In practice, this flue is returned through the water, to still further extend the heating surface, and improve the appearance of the apparatus; but it is shown only carried straight through in the section to simplify the drawing.

The flue (L L) is turned up at both ends, but at one end the vertical piece of pipe (V) is continued downward to receive the heated products of combustion from a lamp or gas-flame which burns directly below the opening.

The upper end of the chimney (V) is furnished with a plate of metal or damper (F), which, when resting on the top of it, entirely prevents the escape of the heated air in that direction, and the consequence is that it is compelled to pass through the horizontal flue (L L) and up through the chimney (W), most of the heat being parted with on the road. When, therefore, the damper (F) is down the whole of the heat passes through the water-tank, and when the damper is up the whole of it escapes through the chimney (V), none of it going through the water.

It will be understood that if by any means the changes of temperature in the drawer can be made to operate this damper, it will be possible to control the heat of the water by utilising the whole or any part of the heat derivable from the lamp.

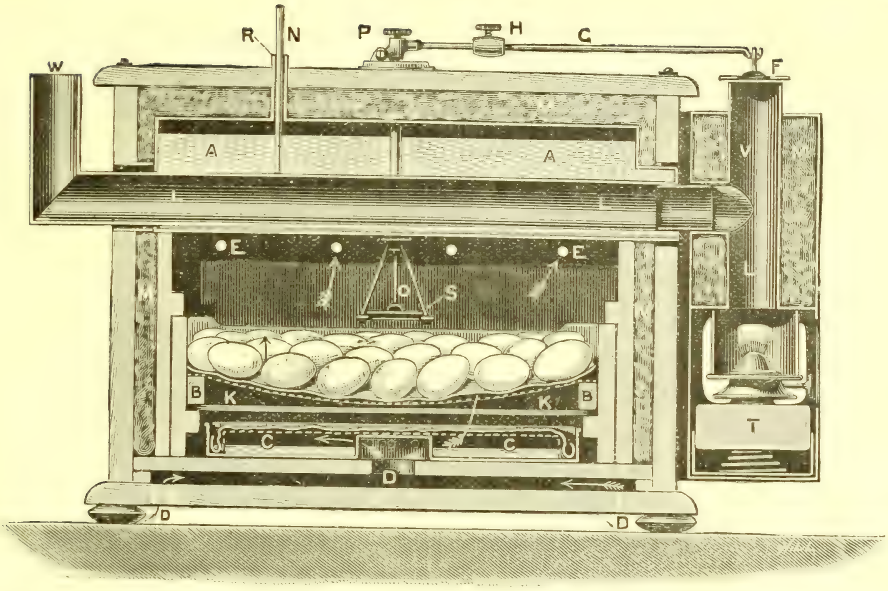
The illustration shows the little damper (F) suspended at the end of a light lever (G), the opposite end of which is pivoted to a frame fixed on the top of the wooden case.

At a short distance from the pivoted end a piece of stiff wire (O) descends quite through the water-tank, a small tube being provided to protect it, so that the water does not interfere with it.

Directly under the end of this wire in the space above the drawer is a little table, which is fixed at such a distance from the water-tank as will allow the drawer to be removed without disarranging it. On this little table will be noticed the brass capsule (S), and it is on this capsule that the lower end of the wire (O) going through the tank rests.

In this way a communication is established between the capsule in the drawer and the damper.

The capsule expands as soon as it gets hot enough to make the enclosed liquid boil, and for the sake of illustration we will suppose that the



Longitudinal Section of a Champion Incubator, showing the Internal Arrangements.

A A. Tank of water.
B B. Moveable egg-tray.
C C. Water-tray.
D D D. Holes for fresh air.
E E. Ventilating holes.
F. Damper.
G. Lever.
H. Lead weight.
K K. Slips of wood.
L L L. Lamp-chimney and flue-pipe.
M M M. Non-conducting material.
N. Tank thermometer.
O. Needle for communicating the expansion of the capsule (S) to the lever (G).
P. Milled-head screw.
R. Filling tube.
S. Thermostatic capsule.
T. Petroleum lamp.
V. Chimney for discharge of surplus heat.
W. Chimney for discharge of residual products of combustion.
The overflow tube is the upper one, situated at the right-hand side of the incubator, and the lower tube is for emptying the tank.

incubator has been in use, but that we have had the drawer out for a few minutes to look at the eggs.

Under these conditions the damper (F) will be resting on the chimney (V), because the capsule has been cooled, and has consequently collapsed; but, if we put the drawer in its place, the heat will in a short time accumulate, and the liquid will boil. When it does so, the top of the capsule will be distended, and the wire (O) will be moved up a short distance. The motion thus communicated to it will be considerably multiplied by the lever, so that for a slight expansion of the capsule the damper will rise far enough from the chimney to allow all the heat from the lamp to escape by that outlet.

In practice, we seldom find the damper rise more than 1-8th or 1-16th of an inch, such rise depending entirely on the excess of heat to be disposed of; for it must be understood that only the surplus will be shunted out of this chimney. The position of the damper, therefore, furnishes a most reliable index of the heat required, for if the damper be found to stand more than 1-8th of an inch above the top of the chimney, more gas is being burned than is needed, and the flame may be lowered until the most economical point is reached; but the flame of the lamp or gas must always be turned a little higher than is absolutely necessary, so that there shall be at all times a reserve to provide against a fall of temperature in the external air.

Should the pressure of the gas increase or the lamp-flame be turned too high, that will make no appreciable difference to either the water or the drawer, as the little damper will rise and shunt the surplus instead of sending it through the water-tank, a variation of 1-10th of a degree being quite sufficient to shunt the whole of the heat out at the top of the chimney.

If the incubator be started and no attempt be made to regulate it, the heat will increase until it reaches a temperature between 97° and 100° F., beyond which it will not rise, no matter how high the flame be turned. But 100° F. is too low a temperature for successful incubation. Therefore, when the apparatus has been working steadily at this temperature for an hour or two, the lead weight (H) must be moved along the lever towards the damper, a little at a time, until a steady heat is registered on the drawer thermometer, the drawer being kept closed the whole time. After experiments on temperature carried on without intermission for two years, the makers find that in cold weather the egg drawer may be kept a degree or two above 104°, and in hot weather a degree or two below 104° F. When the air in the room in which the incubator is placed stands between 50° and 70° F., the best temperature for the drawre is 104° F. For water-fowl the temperature may be 2°, or even 3° higher with advantage.

A shallow zinc tray occupies the whole of the space under the egg-drawer, and the runners of the latter are so arranged that the tray is left behind when the drawer is taken out.

The water in this tray requires replenishing about once in a week or ten days.

There are holes in the bottom and also at advantageous points round the upper part of the drawer space, through which a regular current of air circulates.

Six or eight times as much air as is necessary for the supply of all the chickens which can be hatched in any particular sized incubator passes through these ventilating holes; consequently the air in the drawer is always in a fit state for respiration.

All the air which enters the incubator is filtered through a piece of coarse canvas kept damp by water in the tray (C).

The source of heat may be a paraffin lamp, as shown in the section, but where coal or air gas can be obtained the trouble of trimming and filling the lamp will be avoided.

The lamp once trimmed will burn from 24 to 30 hours, and no special care is required in manipulating it, the burner adopted being much the same as those used in ordinary table-lamps. The lamp should be refilled and the wick trimmed every 24 hours.

By putting slips of wood under the egg-tray, the bottom may be raised or lowered at pleasure, according to the size of the eggs employed. The bottom should be packed up until the top of the nearest egg is level with the under side of the thermometer bulb.

The times of incubation for eggs are as follows:

	Days.		Days.
Ostrich . . .	40	Pea-fowl . .	28
Emu	60	Duck . . .	28
Swan . . .	42	Pheasant . .	24
Goose . . .	35	Hen	21
Turkey . . .	28		

IN'CUBUS. See NIGHTMARE.

IN'DIA RUB'BER. See CAOUTCHOUC.

INDICATORS. See VOLUMETRIC ANALYSIS.

INDIGES'TION. See DYSPEPSIA.

IN'DIGO. *Syn.* INDICUM, PIGMENTUM INDICUM, L. A blue dye-stuff extracted from several plants growing in India and America, especially from the leguminous species *Indigofera tinctoria, I. anil, I. disperma, I. pseudotinctoria,* and *I. argentea,* and in India also from *Nevium tinctorium.* It does not occur ready formed in the plant, but as a colourless pigment in combination with lime or an alkali, and to some extent as a glucoside, 'indican;' these are split up by fermentation, the former yielding indigo-white, the latter indigo-blue. The method of manufacture consists in steeping the plant in water until fermentation sets in; the colouring matter dissolves in the water, forming a yellow solution, which is drawn off from the rest of the vegetable matter, and agitated and beaten to bring it freely into contact with the air for about 2 hours; this treatment causes the indigo to form and settle down as a blue precipitate; this is compressed and cut, while soft, into cubical cakes, and dried by artificial heat. To hasten the formation of the indigo, a little lime water is sometimes added to the yellow solution. The indigo of commerce contains INDIGO-BLUE or INDIGOTIN, its most important constituent, and in addition INDIGO-RED, and many other substances, some of which must be regarded as accidental impurities or adulterations. Indigo has also been prepared artificially in the following manner:—Benzalchloride is made by chlorinating toluene, and converted by treatment with steam into benzaldehyde; this is nitrated, when ortho-nitro-benzaldehyde is formed together with some other compounds. It is converted by treatment with acetic anhydride into ortho-nitro-cinnamic acid, which is then treated with bromine, and yields a dibromide. This is decomposed with alcoholic potash, and the potassium salt of ortho-nitro-phenyl-proprolic acid ('proprolic acid') which is formed is decomposed with hydrochloric acid, and the free acid thus liberated is converted by reduction into indigo-blue. Or the benzalchloride is converted by heating with sodium acetate into cinnamic acid; this is nitrated, and the ortho-nitro-cinnamic acid formed is treated as described above. But these methods have not yet been carried out at a low enough cost to make them pay on the large scale, and the indigo of commerce is still almost entirely derived from natural sources.

Prop. Tasteless; scentless; of an intense blue colour, passing into purple; when rubbed with a smooth hard body, it assumes a coppery hue; insoluble in water, cold alcohol, ether, alkalies, hydrochloric acid, dilute sulphuric acid, and the cold fixed and volatile oils; slightly soluble in boiling alcohol and oils; freely soluble in concentrated sulphuric acid, and, when decoloured or reduced (to *indigo-white*) by contact with deoxidising substances, in alkaline lyes; soluble in creosote; its colour is destroyed by chromic acid, nitric acid, and chlorine, and it is oxidised to *isatin;* when suddenly heated, it gives off rich purple fumes, which condense into brilliant copper-coloured needles.

Pur. The best indigo is that which has the deepest purple colour, that assumes the brightest coppery hue when rubbed with the nail; its fracture is homogeneous, compact, fine-grained, and coppery; its powder is of an intensely deep blue tint, and light enough to swim on water; and it leaves only a fine streak when rubbed upon a piece of white paper. It should dissolve completely in sulphuric acid, and allow itself to be suspended in water without having a sandy or earthy residue in either case. When quickly heated it should evolve purple vapours, and when ignited should leave only a slight amount of white ash. In general, when indigo is in hard, dry lumps of a dark colour, it is considered of bad or inferior quality. Indigo when in hard or brittle lumps, or in dust or small bits, is often adulterated with sand, pulverised slate, and other earthy substances.

Estim. Various methods for estimating the value of samples of indigo have been proposed, but none of them can be depended upon to give perfectly accurate results. The plan recommended by O'Neill is perhaps the best; it is performed as follows:

Weigh 25 gr. of a fair sample of the indigo finely ground; and to soften or disintegrate it still further, boil it for a short time with weak caustic soda, and then, if there be any soft lumps or clots, strain through calico; mix this with 3 quarts of water in a narrow-necked bottle which it will nearly fill, and add 400 gr. of quicklime, which has been slaked as perfectly as possible;

shake well up and add a 1000 gr. measure of solution of green copperas (protosulphate of iron) at 30° Tw.; cork the bottle closely, and leave it for 3 days, frequently shaking it in the interval. The indigo will be dissolved by this time; 1 quart of the clear solution is drawn off, shaken up in a bottle to oxidise it, acidified with acetic acid, and the pure indigo (INDIGOTIN) collected upon a filter, dried, and weighed. Four times the weight of the pure indigo is the percentage of indigo in the sample.

As somewhat simpler tests of the value of a sample of indigo we may mention the following:

When dried at 100° F. it should not lose more than 3% to 7% of its weight; and when ignited the residue should not exceed 7% to 9·5% of the weight of the sample.

A solution of indigo in sulphuric acid is prepared containing a known weight of the sample in a known volume, and run from a burette into a known quantity of bleaching-powder solution till a permanent coloration is first produced, when the quantity used will be inversely proportional to the colouring strength of the sample. The best way is to compare this quantity with that of a standard solution of pure indigo-blue (obtained from sublimation) required to produce a permanent coloration with the same amount of the bleaching-powder solution.

The strength of two samples of indigo may be compared in the following manner:—1 grm. of each sample is dissolved in 20 grms. fuming sulphuric acid, and the solutions are diluted to 3 litres with water, and allowed to settle. Equal volumes of the clear supernatant liquid from each sample are placed in two Nessler glasses, and water is run from a burette into the solution with the deeper tint until it has the same tint as the other solution. If x c.c. were placed in each Nessler glass, and y c.c. water added from the burette, then $(x+y):x$ is the ratio of the colouring strengths of the two samples. This test is valuable because it is simple, and is not vitiated by the substances commonly used to adulterate indigo.

Uses. As a dye-stuff indigo is of great importance, both from the beauty and permanence of the colour it yields, and from the ease with which it is applied to fabrics of all materials. As a medicine it has been employed in various affections of a spasmodic character, as chorea, convulsions, epilepsy, hysteria, &c. In large quantities it often induces giddiness, vomiting, and diarrhœa; and when continued for some time, muscular twitchings, resembling those arising from strychnine.—*Dose.* Beginning at about 15 gr., and gradually increased to 1, 2, or even 3 dr., at which it should be continued for 3 or 4 months; made into an electuary with honey or sugar, to which some aromatic may be added. See INDIGO DYE, INDIGOTIN, &c.

Indigo, Sul′phate of. *Syn.* SULPHINDYLIC ACID, SULPHINDIGOTIC A., SAXONY BLUE, SOLUBLE INDIGO.

Prep. By gradually adding indigo (in fine powder), 1 part, to fuming sulphuric acid (Nordhausen sulphuric acid), 5 parts, or oil of vitriol, 8 parts, contained in a stone-ware vessel placed in a tub of very cold water, to prevent the mixture heating; the ingredients are stirred together with a glass rod at short intervals until the solution is complete, after which the whole is allowed to repose for about 48 hours, by which time it becomes a homogeneous pasty mass of an intense blue colour, which in a dull light appears nearly black.

Obs. In this state it forms 'BARTH'S BLUE,' or the 'CHEMIC BLUE' or 'INDIGO COMPOSITION' of the dyer. Diluted with about twice its weight of soft water, it is converted into the 'SAXONY BLUE' or 'LIQUID BLUE' of the shops, also used for dyeing. When commercial sulphate of indigo is diffused through a large quantity of water, nearly boiling, and wool (old white flannel rags, &c.) is macerated in it for some time, the latter absorbs the whole of the sulphate and is dyed blue, whilst the liquor assumes a greenish-blue colour. Wool, so prepared, when well rinsed in cold water, and boiling for some minutes in a large quantity of that liquid containing 1% or 2% of carbonate of potassa, or a quantity equal to about 1-3rd that of the indigo originally employed, gives up its blue colour, and becomes of a dull brown. The liquid is now a rich blue-coloured solution of sulphindylate of potassa, from which the salt may be obtained by cautious evaporation. This compound is prepared, on the large scale, by diluting sulphate of indigo with about 12 times its weight of soft water, and imperfectly saturating the solution with carbonate of potassa; the sulphindylate falls down as a dark blue coppery-looking powder, soluble in 140 parts of cold water, and in about 90 parts of boiling water. This substance is kept both in the moist and dry state, and is variously known in commerce as 'DISTILLED INDIGO,' 'PRECIPITATED INDIGO,' 'SOLUBLE INDIGO,' 'INDIGO PASTE,' 'BLUE CARMINE,' 'DISTILLED BLUE,' 'SOLUBLE BLUE,' &c. It is extensively used in dyeing; and when mixed with starch whilst in the moist state, and made into cakes or knobs, it constitutes the finest variety of the 'BLUE' used by laundresses for tingeing linen. The ammonia and soda salts may be prepared in the same way as the potassa salt, by substituting the carbonates of those bases for carbonate of potassa. The ammonia salt is very soluble.

Indigo, Chinese Green or Lo-kao. Prepared in China from the barks of *R. tinctorius*, Waldst and Kit. (*R. chlorophorus*, Dcne.), and *R. davuricus*, Pall. (*R. utilis*, Dcne.), and used for dyeing various shades of green. It has been introduced in Lyons for dyeing silks.

Indigo Plant, Chinese (*Polygonum tinctorium*, Lour.). Known as Tjok in Corea.

Indigo, Wild (*Baptisia tinctoria*, R. Br.). Used as an astringent in North America.

INDIGO-BLUE. See INDIGOTIN.

INDIGO DYE. There are 2 methods of preparing solutions of indigo for dyeing: 1, by deoxidising it, and then dissolving it in alkaline menstrua; 2, by dissolving it in sulphuric acid. The former method is used in preparing the ordinary INDIGO VAT of the dyers.

1. (*a*) THE COPPERAS VAT. The properties of the materials used in this vary considerably. The following may be taken as an example:

10	grms. indigo, finely pulverised		1 lb.
15 to 20	„ copperas	. . .	$1\frac{1}{2}$ to 2 lbs.
25 to 30	„ burnt lime	. . .	$2\frac{1}{2}$ to 3 lbs.
1	litre water	. . .	10 galls.

The indigo is ground to an impalpable pulp in a wet mill and added to the vat; the copperas, previously dissolved in hot water, is then added, and the whole is left to cool. Finally, the lime, slaked with water and made up into a thin milk, is added, and the whole well raked up with a wooden rake. Some dyers leave the reduction in the vat to act for 24 hours before they use it, and keep raking it every 4 hours during this time. As a rule, several vats are worked at the same time, and the goods are dipped first in the one and then in the other until the desired shade is produced. After every dip the yarn is wrung, care being taken that the liquor falls back again into the vat. The yarn is then allowed to lie, when the change of colour, or greening, will be soon apparent. A disadvantage of this method is the large amount of sediment (ferric oxide) formed, necessitating deep tanks, and a certain time for settling after it has been agitated.

(*b*) THE ZINC or COMPOSITION VAT. In this zinc dust, known as 'composition' or 'preparation,' is employed as the reducing agent. The following is an example of the proportions of materials used:

10 grms.	finely ground indigo	1 lb.
5 „	'preparation'	½ lb.
10 „	burnt lime	1 lb.
2 to 3 litres	water	20 to 30 galls.

The reduction takes place in from 12 to 18 hours, the vat becoming successively greyish blue, green, yellowish green, and finally yellow in colour. Occasional stirring and raking is necessary to remove the froth caused by the evolution of hydrogen, and if there is too much frothing some of the composition should be removed from the bottom. As a rule, the vat is sufficiently settled in one hour to allow the cotton to be dyed. The advantage of this vat is that it forms less sediment, and that heavier, than the copperas vat, and the settling therefore takes place more quickly; also more work can be had out of the same vat, because the sediment does not accumulate so quickly, and less indigo is wasted by being carried down with it.

(*c*) THE HYDROSULPHITE (*Schützenberger* and *Lalande's*) VAT. To set a vat, say 6 feet square by 7 feet deep:

Fill with clear water.
Take 78 lbs. bisulphite of soda.

Mix in a zinc or galvanised pail for 10 minutes with
6 lbs. zinc 'preparation,'
and add this mixture to the vat; then add
6 lbs. dry-slaked lime,
and indigo solution sufficient for the shade required.

Cotton is dyed cold in this vat, and it is advisable to have an excess rather than a deficiency of lime. The vat should feel soft and slippery.

To replenish the vat, for every 100 lbs. of goods to be dyed, add
10 lbs. bisulphite of soda,
previously mixed for 10 minutes with
13 oz. zinc 'preparation;'
then add
½ lb. slacked lime,
and indigo solution to shade.

(*d*) THE FERMENTATION (or GERMAN) VAT. For a vat of the capacity of 14,000 to 15,000 litres (320 to 350 galls.):

Take
1 bag of bran,
about 2 litres treacle (½ gall.),
20 kilos soda-ash (45 lbs.),
10 kilos indigo, very finely ground in water (22½ lbs.).

By means of a steam pipe the temperature is raised to 60°—70° C. (140°—160° F.). Fermentation will take place spontaneously if the vat is left to itself, but it is advisable to start it by adding a small portion from the bottom of another vat already in fermentation. The vat is left to itself for a few days, being merely raked twice in every 24 hours until the reduction is complete. The wool is then introduced in a kind of basket, which is immersed in the vat, but not allowed to touch the bottom. The wool is gently moved about in this for 15 to 20 minutes, the basket is then raised bodily from the vat, the liquor being allowed to drain back, and the process is repeated till the proper shade is acquired. 5 or 6 dips can be made every day. Every evening after the work is over, the vat is stirred up after first adding—

About 10 litres bran (2 to 2½ galls.),
½ litre treacle (about 1 pint),
2 kilos soda (4½ lbs.),
5 „ indigo (10 to 12 lbs.),

and a certain amount of lime, which can be only determined by practical experience. A good vat is of a nice yellow colour, with a bluish froth at the top of the liquor, and a slight smell of ammonia; the liquor when raked should show bluish veins, and the bottom should be of a greenish hue. The conduct of this vat, as indeed of all indigo vats, requires a large amount of practical experience.

It has been proposed (by *Benoist*) to keep the fermentation more under control by using a mixture of glucose and potato-starch, made soluble by boiling with carbonate of soda, and a special ferment capable of reproducing itself at 70° C. (140° F.). But in practice this method is found to offer no advantages over the older one.

Obs. The copperas, zinc, and hydrosulphate vats are employed for dyeing cotton, the fermentation and hydrosulphite vats for dyeing wool. Indigo being an expensive dye-stuff, the cost of dyeing with it is often reduced by 'lopping' the indigo-dyed goods with cheaper colours, such as methyl-violet and logwood. But these colours are not fast, as they are generally applied without any previous mordanting. Indigo-dyed goods are also occasionally dyed over a 'bottom' of cutch-brown on Cachou de Laval; or sometimes a variety of aniline black is used, but this loses a great deal of its fastness through undergoing reduction in the indigo vat.

2. Solution of sulphate of indigo is added to water as required, and the goods, previously boiled with alum, are then immersed in it, and the boiling and immersion are repeated until the wool becomes sufficiently dyed.

Obs. With this every shade of blue may be dyed, but it is most commonly employed to give a ground to logwood blues. The colouring matter has affinity for woollen and silk with or without 'mordant,' but none for cotton. A solution of soluble indigo (sulphindylate of potassa or soda), in water very slightly acid with sulphuric acid, imparts a very fine blue to cloth, superior in tint

to that given by the simple sulphate. See DYEING, &c.

INDIGO-PUR'PLE. *Syn.* PHŒNICINE. The name given by Mr Crum to the purple precipitate obtained by filtration from a solution of indigo in fuming sulphuric acid, when largely diluted with water.

INDIGO-RED. *Syn.* INDIGO-RESIN, RED RESIN OF INDIGO. This is prepared by boiling alcohol (sp. gr. ·830) on powdered indigo previously exhausted by digestion in dilute acids and in a strong alkaline solution. When heated, it is converted into a white sublimate (deoxidised indigo-red), but recovers its red colour by the action of nitric acid.

INDIGO-WHITE. $C_{16}H_{12}N_2O_2$. *Syn.* INDIGOGENE, INDICYLE, REDUCED INDIGO, HYDROGENISED I., HYDRATE OF I. Reduced or deoxidised indigo-blue.

Prep. The yellow alkaline solution obtained by one or other of the processes noticed under INDIGOTIN is carefully protected from the air, both before and after precipitation with hydrochloric acid; and the precipitate, after being rapidly washed with recently boiled distilled water, or with very dilute sulphurous acid, is drained on a filter, dried *in vacuo*, and then at once transferred to a well-stoppered bottle.

Prop., &c. A greyish-white mass of minute crystals, generally light blue on the surface, and rapidly turning blue on exposure to the air; soluble in alkalies, alcohol, and ether, to which it imparts a yellow colour. These solutions deposit indigo-blue on exposure to the air. A solution of this substance constitutes the indigo vat of the dyer (see *above*).

INDIGO'TIN. $C_{16}H_{10}N_2O_2$. *Syn.* CERULIN, INDIGO-BLUE. This is the pure blue principle of indigo. It appears to stand in the same relation to indigo-white as quinone does to hydroquinone. It contains two atoms of hydrogen less than indigo-white, into which it is converted by reduction. Indigo-white, on the other hand, when oxidised by contact with the air yields indigo-blue. By further oxidation of the latter, isoline, $C_{16}H_{10}N_2O_4$, is formed.

Prep. 1. Indigo (in fine powder) is digested successively in dilute hydrochloric acid, solution of potassa, and alcohol; the dried residuum is crude indigotin.

2. Indigo (in fine powder), 1 part; green sulphate of iron, 2 parts; hydrate of lime, 3 parts; water, 15 parts; mix, agitate occasionally until the colour is destroyed, then decant the clear portion, precipitate with dilute hydrochloric acid, and wash the powder first with water, and then with boiling alcohol, until the latter ceases to acquire a yellow colour.

3. Caustic soda and grape-sugar, of each, 1 part; water, 20 parts; powdered indigo, 5 parts; mix, and proceed as last. The above are essentially the same as the indigo vat, but on the small scale.

4. The first process for estimating the value of indigo given under INDIGO is a good process for obtaining indigotin.

Obs. The product from all the above exceeds 50% of the indigo operated upon.

5. (*Taylor.*) Powdered indigo, 2 parts; plaster of Paris, 1 part; water, q. s. to reduce the mixture to a thin paste; spread the mass evenly upon an oblong iron plate to the depth of about 1-8th inch, and dry it by a gentle heat. It must then be held over the flame of a spirit lamp, when a disgusting odour will be evolved, the mass will begin to smoke, and in a few minutes will be covered with a heavy purple vapour, which will condense into brilliant flattened prisms or plates of an intense copper colour, forming a thick velvety coating over the surface immediately exposed to the heat. Should the mass catch fire, it may instantly be extinguished by a drop of water let fall upon it.—*Prod.*, 15% to 18%. See INDIGO, &c.

INDIUM. In = 113·4. A very rare metallic element belonging to the same group as aluminium and gallium, which metals it much resembles in its chemical properties. It was discovered by means of the spectroscope by Messrs Reich and Richter in a specimen of zinc-blende from Freiberg in 1863, and has since been detected in the flue-dust of zinc furnaces, and in blende from various localities, in which it occurs in exceedingly minute quantities associated with other metals.

The following process for the detection of indium in zinc-blende, and its extraction from the same source, is given by Winkler. Precipitate the hydrochloric acid solution of the roasted ore with metallic zinc at the boiling heat; dissolve the precipitate in nitro-hydrochloric acid; remove the arsenic, cadmium, &c., by sulphuretted hydrogen, and precipitate the indium as oxide by barium carbonate. Should this precipitate contain any iron, it must be removed by redissolving it, heating the solution with sodium sulphate, and digesting it with barium carbonate in a closed vessel. The indium may also be precipitated either directly from the original solution by barium carbonate, or from a solution containing sulphuric acid, by neutralisation with sodium carbonate, till a precipitate begins to form, and addition of sodium acetate; it is then precipitated as a basic sulphate containing zinc.

Indium may be obtained in the metallic state from the reduction of its oxide by means of hydrogen; charcoal or carbonaceous fluxes are not good reducing agents, as their employment necessitates a very high temperature, and loss from volatilisation occurs. Sodium is found to be the best reducing agent when large quantities of the metal are required.

Böttger's method is to precipitate the indium by zinc, to press the spongy metal so obtained in hot water, then to submit it to pressure in a screw press between filtering-paper, and finally to melt it with cyanide of potassium.

Prop. Indium is a soft, white, durable metal, somewhat resembling cadmium, wholly destitute of crystalline structure. Its specific gravity, which is 7·421 at 16·8° C., is not altered by rolling or hammering. When heated in the air it melts at 176° C. (349° F.) without becoming oxidised; at a temperature above this, however, it becomes covered with a coating of suboxide, becoming gradually changed into the yellow sesquioxide. Indium is less volatile than either cadmium or zinc. It dissolves slowly in dilute sulphuric and

hydrochloric acids, hydrogen being given off. In strong hydrochloric acid it dissolves rapidly. Nitric acid oxidises it, evolving at the same time nitric oxide; whilst sulphuric acid converts it into anhydrous sulphate.

When examined by means of the spectroscope the flame of indium reveals two brilliant bands—a violet and a blue one.

Indium is completely precipitated from a solution of its acetate, as well as from neutral solutions of its salts in general, by sulphuretted hydrogen. Ammonia, neutral sodium carbonate, and acid sodium carbonate throw down white precipitates insoluble in excess of the precipitant; caustic potash and soda produce a white precipitate of indium hydrate, soluble in excess. Barium carbonate precipitates it completely. Potassium ferrocyanide gives a white precipitate.

Indium forms compounds with bromine, chlorine, iodine, oxygen, and with several of the organic and inorganic acids.

INDURA'TION. In *pathology*, an increase in the consistence of any portion of the body, usually resulting from chronic inflammation, pressure, or friction.

INFANTS, Food for. For the newly born and very young of all mammiferous animals no food is so expressly and admirably adapted as that drawn from the mother. In the nourishment of the babe from the maternal breast lies the soundest condition for its physical wellbeing and growth, subject to the qualification that the mother must be in good health, which, of course, implies that she must be well fed. This latter essential fulfilled, it is very wonderful to note how nature makes provision for the proper nourishment of the offspring by converting even a weakly and frequently ailing mother into a strong one during the period of suckling.

There may be, and doubtless are, many circumstances in which lactation cannot be practised with safety either to mother or child; but, where such circumstances do not exist, the practice of seeking the vicarious services of the wet-nurse, or of having recourse to other than the maternal milk, for many reasons calls for remonstrance and reproof.

We may emphasise this by the following quotation from Dr West's admirable work, 'Diseases of Infancy and Childhood.' He says: "The infant whose mother refuses to perform towards it a mother's part, or who by accident, disease, or death is deprived of the food that nature destined for it, too often languishes and dies. Such children you may see with no fat to give plumpness to their limbs—no red particles in their blood to impart a healthy hue to the skin, their face wearing in infancy the lineaments of age; the voice a constant wail; their whole aspect an embodiment of woe. But give to such children the food that nature destined for them, and if the remedy do not come too late to save them the mournful cry will cease, the face will assume a look of content, by degrees the features will disclose themselves, the limbs will grow round, the skin pure red and white."

But although the maternal aliment (or, failing this, that supplied from the breast of a young and healthy wet-nurse, who has been recently confined) is undoubtedly the best adapted for infantile nutrition, it fortunately happens that in circumstances where the infant is unable to be fed from either of these sources, we have a very valuable substitute in the milk of the cow, the similarity of which, in composition to woman's milk, will be seen at once by studying the following table, arranged by Dr Letheby:

	Woman's Milk.			Cow's Milk.
	Max.	Min.	Average.	Average.
Casein . . .	4·36	2·97	3·52	3·64
Butter . . .	5·18	4·45	4·02	3·55
Sugar of milk .	4·43	3·29	4·27	4·70
Various salts . .	0·26	0·38	0·28	0·18
Total solids . .	14·20	11·09	12·09	12·70
Water . . .	85·50	88·91	87·91	87·30
Total . .	100·00	100·00	100·00	100·00

The milk of the cow being rather richer in solids than that of women, it is considered desirable to somewhat dilute the former when it is used as food for the infant. Dr Letheby recommends the addition to it of a third of water, with a little sugar to sweeten it, and to render it more acceptable to the baby palate. It cannot be too forcibly insisted upon that immeasurably the best and safest food for an infant, next to human milk, is the milk of the cow, *and nothing else*, until it reaches the age of eight or nine months. It is perhaps needless to state that the milk must be perfectly pure and unadulterated, and that it will fail of being this if yielded by an unhealthy cow. The animal's food and habitat also exercise an important influence on the quality of the milk, that given by grass-fed cows roaming in open pastures undoubtedly being the best and richest.

Different cows yield different qualities of milk; hence, when milk from any particular cow suits an infant, it has been found desirable not to change it.

The newer and fresher the milk the better is it adapted for the child's use; that which has in the least become soured should be especially rejected.

Sometimes even fresh and good milk is found to disagree with a child. When this is the case it may be remedied by adding a little lime-water to it previous to its being drunk. If it were practicable and within the means of every family to keep their own cow, so that the infant could be fed with the milk directly it came from the animal, nature's example in giving it direct from the mother's breast might be followed. The writer remembers, some years ago, the Princess of Wales travelling with her baby on a voyage to and from Denmark, and being accompanied by her bovine purveyor in the shape of an Alderney.

In hot weather, more particularly, if milk be kept even for a short time, it is liable to become

acid, or 'to turn,' as it is called. It is, therefore, always desirable to keep it in a cool cellar till required for use, and in very hot weather it should be stood in ice.

The daily allowance of milk for a child during the first month of its life is 2 or 3 pints. M. Guillot says 2½ lbs. avoirdupois is the least the babe can properly subsist on. He weighed several infants before and after they had taken the breast, and found that they had gained in weight, in quantities varying from 2 oz. to 5 oz.

Opinion is divided as to the value of condensed cow's milk as a food for infants. Its chief merit seems to be that it affords a substitute for the natural milk in cases where this latter is not obtainable, or where, in consequence of disease amongst the cows of a neighbourhood, it cannot with safety be consumed. Since the maternal fluid, without undergoing alteration or modification, forms so perfect and model a food for infants, it does not seem an unreasonable inference that the milk from the cow, which so nearly approaches it in composition and qualities, should prove most advantageous when partaken of under similar conditions. It has been asserted that condensed milk is inferior in strengthening qualities to the natural cow's milk. If this be the case it is certainly not due, according to Mr Wanklyn, to any removal of the constituents of the latter. In his useful little work on 'Milk Analysis' Mr Wanklyn says:—"A year ago a report was spread that these preserved milks were preserved skim-milk, and not preserved new milk. I have myself examined the principal brands of preserved and condensed milk which are in the London market, and find that the milk which has been condensed, or condensed and preserved, had been charged with its due proportion of fat."

The physiological facts that in an early stage of infancy the digestion is very feeble, and that until an infant has cut its first teeth there is but little, if any, secretion of saliva, which latter is essential for the conversion in the system of starch into sugar, point, therefore, to the imprudence of feeding very young infants upon so-called 'infants' foods,' where these consist of amylaceous substances. The starch of which these latter are composed not only fails to become assimilated, and therefore to produce any nutrient effect, but clogs up the lower parts of the bowels, and thus gives rise to a train of evils, amongst which may be included indigestion, diarrhœa, vomiting, and not infrequently convulsions and death.

The difference in the mortality between infants under 1 year of age who annually die of convulsions in England and Scotland is attributed to the fact that whereas the English mother feeds her offspring on thick spoon-food, the Scotch woman nourishes hers from the breast. In the 'Fourteenth detailed Annual Report of the Registrar-General of Scotland' it is stated that "the English practice of stuffing their babes with spoon-meat occasioned the death by convulsions of 23,198 children under 1 year of age during the year 1868, out of 786,858 births; in other words, caused 1 death from convulsions in every 34 of the children born during the year in England. In Scotland, during the same year, only 312 infants under 1 year of age fell victims to convulsions out of 115,514 children born during the year; in other words, 1 death from convulsions in every 370 born during the year."

When a child has reached the age of 8 or 9 months the judicious use of farinaceous foods is not only unobjectionable but desirable; but even then it is most important to increase the quantity of the food very cautiously with the age, as well as to see that it has been well baked and afterwards boiled before being partaken of. In all cases it should be mixed with the milk.

When the child has reached the age of 20 months Dr Letheby advises the quantity of farinaceous food to be still further increased, and with a little egg given in the form of pudding until it attains its third year. At this period the child's diet may also include bread and butter, and at the end of it well-boiled potato with a little meat gravy.

From the 3rd to the 5th year he prescribes a small quantity of meat, and at the end of the 9th year the usual food of the family. During all these periods the use of milk as an important article of the dietary is enforced.

The following table by the late Dr Edward Smith, exhibiting the proportions between the daily quantities of carbon and nitrogen required at different periods of human existence, illustrates the great preponderance of nitrogen demanded by the infant over those who succeed him in the scale of age:

	Carbon.	Nitrogen.
In infancy	69	6·72
At ten years of age	48	2·81
At sixteen years of age	30	2·16
At adult life	23	1·04
In middle life	25	1·13

See MILK.

IN'FANTS' PRESER'VATIVE (Atkinson's). Carbonate of magnesia, 6 dr.; white sugar, 2½ oz.; oil of aniseed, 20 drops; compound spirit of ammonia and rectified spirit, of each, 2½ fl. dr.; laudanum, 1 fl. dr.; syrup of saffron, 1 oz.; caraway water, q. s. to make the whole measure 1 pint. Antacid, anodyne, and hypnotic.

INFEC'TION. *Syn.* CONTAGION. The communication of disease, either by personal contact with the sick or by means of effluvia arising from their bodies. Attempts have been made to restrict the term contagion to the former, and infection to the latter, but this distinction is now discarded by the majority of writers. The following are the principal diseases which are commonly regarded as contagious:—Chicken-pox, cholera, cow-pox, dysentery, erysipelas, glanders, gonorrhœa, hooping-cough, hydrophobia, itch, measles, mumps, ophthalmia (purulent), plague, scald-head, scarlet fever, smallpox, syphilis, yaws. See DISINFECTANT, &c.

INFECTIOUS DISEASE (NOTIFICATION) ACT, 1889. The following provisions are important to householders and heads of families:

SEC. 1. Where an inmate of any building used for human habitation within a district to which this Act extends is suffering from an infectious disease to which this Act applies, then, unless such building is a hospital in which persons suffering from an infectious disease are received, the following provisions shall have effect, that is to say:

a. The head of the family to which such inmate (in this Act referred to as the patient) belongs, and in his default the nearest relatives of the patient present in the building or being in attendance on the patient, and in default of such relatives every person in charge of or in attendance on the patient, and in default of any such person the occupier of the building, shall, as soon as he becomes aware that the patient is suffering from an infectious disease to which this Act applies, send notice thereof to the medical officer of health of the district.

b. Every medical practitioner attending on or called in to visit the patient shall forthwith, on becoming aware that the patient is suffering from an infectious disease to which this Act applies, send to the medical officer of health for the district a certificate stating the name of the patient, the situation of the building, and the infectious disease from which, in the opinion of such medical practitioner, the patient is suffering.

SEC. 2. Every person required by this section to give a notice or certificate who fails to give the same, shall be liable on summary conviction in manner provided by the Summary Jurisdiction Acts to a fine not exceeding 40*s.*;

Provided that if a person is not required to give notice in the first instance, but only in default of some other person, he shall not be liable to any fine if he satisfies the Court that he had reasonable cause to suppose that the notice had been duly given.

SEC. 5. (1) The local authority of any urban, rural, or port sanitary district may adopt this Act by a resolution passed at a meeting of such authority; and 14 clear days at least before such meeting, special notice of the meeting, and of the intention to propose such resolution, shall be given to every member of the local authority, and the notice shall be deemed to have been duly given to a member if it is either—

a. Given in the mode in which notices to attend meetings of the local authority are usually given; or

b. Where there is no such mode, then signed by the clerk of the local authority and delivered to the member or left at his usual or last-known place of abode in England, or forwarded by post in a prepaid letter addressed to the member at his usual or last-known place of abode in England.

(2) A resolution adopting this Act shall be published by advertisement in a local newspaper, and by handbills, and otherwise in such manner as the local authority think sufficient for giving notice thereof to all persons interested, and shall come into operation at such time, not less than one month after the first publication of the advertisement of the resolution, as the local authority may fix, and upon its coming into operation this Act shall extend to the district.

(3) A copy of the resolution shall be sent to the Local Government Board when it is published.

SEC. 6. In this Act the expression 'infectious disease to which this Act applies' means any of the following diseases, namely: Smallpox, cholera, diphtheria, membranous croup, erysipelas, the disease known as scarlatina or scarlet fever, and the fevers known by any of the following names: Typhus, typhoid, enteric, relapsing, continued, or puerperal, and includes as respects any particular district any infectious disease to which this Act has been applied by the local authority of the district in manner provided by this Act.

SEC. 13. (1) The provisions of this Act shall apply to every ship, vessel, boat, tent, van, shed, or similar structure used for human habitation, in like manner as nearly as may be as if it were a building.

(2) A ship, vessel, or boat, lying in any river, harbour, or other water not within the district of any local authority within the meaning of this Act, shall be deemed for the purposes of this Act to be within the district of such local authority as may be fixed by the Local Government Board, and where no local authority has been fixed, then of the local authority of the district which nearest adjoins the place where such ship, vessel, or boat is lying.

(3) This section shall not apply to any ship, vessel, or boat belonging to any foreign Government.

SEC. 15. Nothing in this Act shall extend to any building, ship, vessel, boat, tent, van, shed, or similar structure belonging to Her Majesty the Queen, or to any inmate thereof.

SEC. 16. The expression 'occupier' includes a person having the charge, management, or control of a building, or of the part of a building in which the patient is, and in the case of a house the whole of which is let out in separate tenements, or in the case of a lodging-house, the whole of which is let to lodgers, the person receiving the rent payable by the tenants or lodgers either as his own account or as the agent of another person, and in the case of a ship, vessel, or boat, the master or other person in charge thereof.

INFLAM'MABLE AIR. See HYDROGEN.

INFLAMMA'TION. *Syn.* INFLAMMATIO, L. In *pathology*, a certain state of disease. The common symptoms of inflammation are pain, swelling, heat, and redness, attended with fever, and general constitutional derangement when severe.

The treatment of inflammations, whether trifling or serious, is essentially the same in principle, and only differs in degree. This consists in the adoption of the usual means for lowering the force of the circulation and the frequency of the pulse; of which leeching, purging, a low diet, and the use of refrigerant drinks and lotions, form the most important part. The constitutional derangement or symptomatic inflammatory fever and inflammatory condition of the blood always accompany local inflammation, and progress with its intensity. In inflammations of a more purely local character, cupping or leeching the part immediately affected, or the parts adjacent to it, is in general more appropriate and successful. In these cases the application of refrigerant or sedative lotions, baths, &c., generally proves of much advantage. In cases in which there is induration or dryness of the part, the use of warm embrocations is indicated.

Inflammation often arises from apparently very trifling causes, particularly in persons of a full or bad habit of body, or who indulge in the free use

of malt liquors. In some persons a very trifling local injury, as a slight abrasion, cut, prick, or sprain, produces a considerable amount of tumefaction, attended with severe constitutional excitement. Punctured wounds, sprains, and dislocations commonly furnish the most serious cases of inflammation that depend on mere external injury. In all inflammatory cases of a serious nature the reader is strongly advised to commit himself to the care of a medical practitioner. See ABSCESS, FEVER, TUMOUR, &c.

Inflammation of the Bowels. The common causes are incautious exposure to cold, the use of improper food, and the presence of acrid substances or hardened fæces in the bowels. The more constant symptoms are pain over the abdomen, thirst, heat, and extensive restlessness and anxiety; sickness, obstinate constipation, and a hard, small, quick pulse. In the later stages the pain and tenderness of the abdomen, especially around the navel, become excessive, and there is difficult micturition. In some cases the pain suddenly ceases, the belly becomes tumid, the pulse scarcely perceptible, the countenance ghastly, and the patient dies in a few hours. The treatment consists in blisters, leeches to the abdomen, hot bath and fomentations, aperient clysters, and mercurial purges; with effervescing draughts and opium to allay sickness, followed by diaphoretic salines and gentle aperients. See STOMACH AFFECTIONS, &c.

INFLAMMATORY FE'VER. See FEVER and INFLAMMATION.

INFLUENZA. A term generally applied to a characteristically violent, apparently infectious, and occasionally epidemic catarrh, the symptoms of which are well known. Another form of influenza which is also epidemic, and has been known for centuries as La Grippe, is a disease having many of the characters of intermittent fever or ague, the temperature of the patient often rising to 103° or 104° F., with distinct daily intermissions. There is great prostration and extreme liability to lung and bronchial complications; patients should be kept in bed and treated with tonics and antiperiodics, and be well fed with light nourishing food. The greatest care is necessary in convalescence, as the obstinate colds in the head and chest, pneumonia, and other disorders of the respiratory tract, are common sequelæ, and not infrequently carry off patients who have survived the original disease.

In HORSES. See AMERICAN HORSE DISEASE.

INFU'SION. *Syn.* INFUSUM, INFUSIO, L. A liquid medicine, prepared by macerating vegetable or animal substances in water, at any temperature below that of ebullition.

The mode of preparing infusions is, with most substances, precisely similar to that pursued for making the almost universal beverage—TEA. The ingredients are commonly placed in a stoneware pot or vessel (an 'infusion pot'), previously made hot; boiling water is then poured over them, and the cover being placed on, the whole is allowed to digest together, at first, for a short time, in a warm situation, as on the hob or the fender, and afterwards (the vessel being removed from the heat) until the whole becomes cold. The liquid is then poured from the ingredients, and the latter washed with a little water and slightly pressed; if necessary, the infusion is strained through a piece of clean linen or a hair-sieve for use. During the digestion the ingredients should be occasionally stirred—an important matter often neglected, and not even referred to by most pharmaceutical writers.

The substances employed for making infusions receive the same preliminary treatment as those intended for making DECOCTIONS. Shavings, leaves, and flowers require no previous preparation beyond being pulled asunder; but roots, woods, and other solid substances must be bruised or sliced if in the green or recent state, or bruised or coarsely pulverised if dry, for the purpose of exposing as large a surface as possible to the action of the menstruum.

The substances extracted by water from vegetables by infusion are chiefly gum, mucus extractive, tannin, certain vegetable acids, the bitter and narcotic principles, gum-resin, essential oil, and alkaloids. Some of these substances are only sparingly soluble in water at ordinary temperatures; but more readily so in hot water, and freely soluble in boiling water. The temperature of the water should be therefore proportioned to the nature of the vegetable matter operated on. For mere 'demulcent infusions,' in which starch and gum are the chief substances sought to be dissolved out, and when the active principle is scarcely soluble in water unless at nearly the boiling temperature, boiling water alone should be employed; but when the medicinal virtues of vegetables are soluble in water at lower temperatures it is better to employ hot water (165°—175° F.), and to allow a little longer period for the digestion. In many cases temperate water (from 60°—70° F.), or tepid water (from 80°—90° F.), may be used with advantage, especially in the preparation of 'aromatic bitter infusions,' and in most cases where it is wished that the product should contain as little inert matter as possible; but when water at low temperatures is employed, the period of the maceration must be proportionately increased. By adopting the method of maceration *in vacuo*, or in an atmosphere of carbonic acid, the menstruum may be allowed to lie in contact with the vegetable matter for an unlimited period without decomposition taking place.

Infusions, like decoctions, are liable to undergo spontaneous decomposition by keeping, especially in warm weather, when a few hours are often sufficient for their passage into a state of active fermentation; they should, therefore, when possible, be prepared for use daily, as beyond twenty-four hours they cannot be depended on. The London College directs a pint only to be made at a time, thus very properly regarding them as extemporaneous preparations.

CONCENTRATED INFUSIONS, now so common in the shops, and, unfortunately, so generally used in dispensing, are either made by taking 8 times the quantity of the ingredients ordered in the pharmacopœia, and then proceeding in the usual manner, or by the method of displacement; or, by carefully and rapidly concentrating the simple infusions, by evaporation in a steam or salt-water bath, until reduced to about 1-7th of the original

quantity. In either case the liquid is put into a strong bottle without being filtered, and 10% to 12% of rectified spirit added to it whilst still hot. The cork is then put in and secured down, and the whole agitated for some minutes, after which it is set aside for a week, when the clear portion is carefully decanted from the sediment for sale. Another method, which answers well with the aromatic bitter vegetables, is to take 8 times the usual quantity of the ingredients, and to exhaust them with a mixture of rectified spirits, 1 part, and distilled water, 3 parts; by digestion, or, better still, by percolation. Concentrated infusions made in this way keep well, and deposit scarcely any sediment. Many houses, that are remarkable for the 'brilliancy' and beauty of these preparations, employ 1-3rd spirit of wine and 2-3rds water as the menstruum. It may, however, be taken as a general rule, that for vegetable substances that abound in woody fibre, and contain little extractive matter soluble in water (as quassia, for instance), 1-6th to 1-5th part of spirit is sufficient for their preservation; whilst for those abounding in mucilage or fecula, or that readily soften and become pulpy and glutinous in weak spirit (as rhubarb), 1-5th to 1-3rd is required.

By adopting the method originally suggested by Mr Alsop, infusions may be preserved, uninjured, for a year or longer, without the addition of spirit or any other substance. The only precaution necessary is to keep them in bottles, perfectly filled and hermetically sealed ('Pharm. Journ.,' i, 57).

Before adding the spirit to infusions made with cold water, or with water which is only tepid, it is advisable to heat the liquid to about 185° Fahr. in a water-bath, and after keeping it at that temperature for a few minutes, and allowing it again to become cold, to separate it from the precipitated matter, either by filtration or decantation.

It is often very difficult to render vegetable infusions and decoctions perfectly transparent, a quality always expected in the concentrated preparations. Defecation by repose is always better than filtration, owing to the more or less viscid character of the suspended matter. When this is not sufficient they may be clarified with white of egg (2 or 3 to the gall.), previously beaten up with 5 or 6 fl. oz. of water. Most of the vegetable infusions and decoctions will readily pass the filter, after a very small quantity of acetic, nitric, or sulphuric acid has been added to them. The most obstinate may be rendered 'brilliant,' or 'candle bright,' as the 'cellarmen' call it, by shaking them up, first with about a drachm of dilute sulphuric acid, and afterwards with the whites of 3 or 4 eggs, previously mixed with a few ounces of water, for each gallon of the liquid. This plan is, however, objectionable for many medicinal preparations.

As many infusions which are occasionally employed in medicine must necessarily escape being separately noticed in this work, it may be as well to remark that the infusions of all vegetables that do not exert a very powerful action on the human frame as ordinary herbs and roots may be made by pouring 1 pint of boiling water on 1 oz. of the vegetable matter, and allowing it to macerate for half an hour to an hour. The decoctions of the same vegetables may be made by simply boiling the above ingredients, in the same proportions, for 10 or 15 minutes, instead of operating by mere infusion. With substances of somewhat greater activity, only half the above quantity should be taken; whilst, with the narcotic plants and those possessing great activity, 1 to 2 dr. to water, 1 pint, will be the proper quantity. The ordinary dose of such infusions and decoctions is ½ to 1 wine-glassful (1 to 2 fl. oz.), two, three, or four times a day, as the case may indicate.

Infusion is preferred for all bodies of a delicate texture, which readily yield their active principles to water; and especially when these are either volatile or liable to be injured by the heat of ebullition.

The simple infusions are now less frequently made by the druggist than formerly. In most cases he merely furnishes the ingredients, and the infusions are prepared by either the nurse or patient, by whom they are commonly called 'TEAS.'

*** The following list embraces most of the infusions used in prescribing or noticed in books. Where the proportions of the ingredients are not given, 1 oz. of the medicinal substance, and 1 pint of boiling water are to be taken, and the dose is that referred to above.

Infusion of Ag'rimony. *Syn.* AGRIMONY TEA; INFUSUM AGRIMONII, L. From the fresh tops before the flowers are formed. Vermifuge.—*Dose.* A teacupful 3 or 4 times a day; also used as an astringent gargle and lotion. For internal use, an equal weight of liquorice root (sliced) is commonly added.

Infusion, Al'kaline. *Syn.* INFUSUM ALKALINUM, L. *Prep.* (*Beasley.*) Hickory ash, 1 pint; wood-soot, ¼ pint; boiling water, 1 gall.; in 24 hours decant the clear. "A popular remedy in America for dyspepsia with acidity."

Infusion of Al'oes. *Syn.* INFUSUM ALOËS, L. *Prep.* 1. From hepatic or Socotrine aloes (in powder), 2 dr.; carbonate of potassa, 1½ dr.; boiling water, 1 pint.

2. (Compound: INFUSUM ALOËS COMPOSITUM, L.) *a.* As the COMPOUND DECOCTION OF A. (Ph. L.), but using only a pint of boiling water.

b. (*Fothergill.*) Calumba and rhubarb, of each, 1 oz.; aloes, 2 dr.; lime-water, 16 fl. oz.; spirit of horseradish, 1 fl. oz.; macerate in the cold for 12 hours, and strain. The last 3, like the decoction, are aperient, antacid, stomachic, tonic, and emmenagogue.—*Dose*, 1 table-spoonful to a small wine-glassful, in water. The last one is an admirable medicine in dyspepsia, loss of appetite, and troublesome constipation.

Infusion of Amer'ican Calum'ba. *Syn.* INFUSUM FRASERÆ, L. From the dried root of American calumba (*Frasera carolinensis*). A pure, powerful, and excellent bitter, destitute of aroma, and fully equal to gentian (*Lindley*).

Infusion of Amer'ican Cen'taury. *Syn.* INFUSUM SABBATII, L. From the herb (*Sabbatia angularis*). A pure bitter tonic, without astringency or aroma.

Infusion of Amer'ican Sen'na. *Syn.* INFUSUM CASSIÆ MARYLANDICÆ, L. *Prep.* (*Martin.*) Leaves of American or wild senna (*Cassia Mary-*

landica), 1½ oz.; coriander seed, 1 dr.; boiling water, 1 pint. Purgative.

Infusion of Angel'ica. *Syn.* INFUSUM ANGELICÆ, L. From the root of garden angelica. A warm stomachic and diaphoretic; and, in large doses, aperient. It is a popular remedy in dyspepsia, flatulent colic, and heartburn.

Infusion of Aniseed. *Syn.* ANISEED TEA; INFUSUM ANISI, L. Carminative; an excellent adjunct to purgatives, to prevent griping; given to infants to relieve colic, &c. Dr Prout recommends the use of water at 120° or 125° F.

Infusion, Antiscorbu'tic. *Syn.* INFUSUM ANTISCORBUTICUM, MISTURA ANTISCORBUTICA, L. *Prep.* Water trefoil (*Menyanthes trifoliata*), 1 oz.; orange peel, 2 dr; boiling water, 1 quart; infuse for 8 or 10 hours, strain, and add of compound spirit of horseradish, 5 fl. oz. In scurvy.

Infusion of Ar'nica. *Syn.* INFUSUM ARNICÆ, L. *Prep.* 1. From the flowers of mountain arnica or German leopard's bane (*Arnica montana*). Cottereau orders 1 oz., Dr Pereira ½ oz., and Dr A. T. Thomson, ¼ oz. of the flowers to the pint. The first is the usual quantity. The dose of the first is a table-spoonful; of the second, ½ to 1 fl. oz.; of third, ½ to 1 wine-glassful.

2. (Compound: INFUSUM ARNICÆ COMPOSITUM, L.; Ph. Copenh.) Flowers of arnica, 1 dr; peppermint, 2 dr.; chamomiles, ½ oz.; boiling water, ½ pint.—*Dose*, 1 fl. oz. As the last.

Infusion of Arnica-root. *Syn.* INFUSUM ARNICÆ RADICIS, L. *Prep.* (Ph. Castr. Ruth.) Arnica root, 40 gr.; water, 1 lb.—*Dose*, 1 fl. oz As the above.

Infusion, Astrin'gent. *Syn.* INFUSUM ASTRINGENS, MISTURA, A., L. *Prep.* 1. From oak-bark.

2. Infusion of cusparia, 17 fl. oz.; tincture of catechu or kino, 1 fl. oz.; powdered ipecacuanha, 1 dr.; powdered opium, 12 gr.; mix. In diarrhœa, &c. It must be well shaken before pouring out the dose.

Infusion of Aya-pana (Compound). *Syn.* INFUSUM AYÆ-PANÆ COMPOSITUM. *Prep.* (*Dr Camera.*) Leaves of Brazilian aya-pana, 2 dr.; aniseed, 1 dr.; boiling water, 2 pints.

Infusion of Balm. *Syn.* INFUSUM MELLISÆ, L. *Prep.* (*Plenck.*) Fresh herb, 5 dr.; boiling water, 1 pint; infuse for 15 minutes.

Infusion of Bar'berry. *Syn.* INFUSUM BERBERIS, L. *Prep.* (*Dr Copland.*) From the bark of the barberry shrub (*Berberis vulgaris*). In jaundice, biliary fluxes, and other cases where heat and acrimony prevail; either alone or combined with a little carbonate of soda or potassa, and tincture of calumba.

Infusion of Bark. See INFUSION OF CINCHONA.

Infusion of Bay-leaves. *Syn.* INFUSUM LAURI, I. LAURI NOBILIS, L. From the leaves or the berries of the sweet bay (*Laurus nobilis*). Aromatic, stimulant, and emmenagogue; in very large doses, emetic and poisonous. It is chiefly given in colic, flatulence, paralysis of the extremities, and obstructed menstruation.

Infusion of Bearberry (B. P.). *Syn.* INFUSUM UVÆ-URSI. *Prep.* Infuse bearberry leaves, bruised, ½ oz.; in boiling distilled water, 10 oz.; in a covered vessel for 1 hour and strain.

Infusion of Beef. See ESSENCE, TEA, &c.

Infusion of Belladon'na. *Syn.* INFUSUM BELLADONNÆ. L. *Prep.* 1. (*Dr Paris.*) Leaves of deadly nightshade (dried), 4 gr.; boiling water, 2 fl. oz.; for a dose.

2. (Compound; *Dr Saunders.*) Leaves (dried), ½ dr.; boiling water, 12 fl. oz.; infuse, stain, and to every 7 fl. oz. of the infusion add of compound tincture of cardamoms, 1 fl. oz.

Infusion of Bis'tort. *Syn.* INFUSUM BISTORTÆ, L. *Prep.* (*Radius.*) Bistort or snakeweed root (*Poligonum bistorta*), ½ oz.; boiling water, 1 pint; infuse 2 hours, and strain. In passive hæmorrhages.

Infusion of Black Snake-root. *Syn.* INFUSUM CIMICIFUGÆ RACEMOSÆ, L. In dropsy, rheumatism, and chest complaints.

Infusion of Blessed Thistle. *Syn.* INFUSUM CARDUI BENEDICTI, L. From the whole herb. In small doses it is diaphoretic; in larger ones, tonic, stomachic, and deobstruent; taken warm, it is occasionally given to promote the action of emetics. The properties of carduus benedictus "are such as to lead us to the belief that it has been superseded by other not more efficacious remedies" (*Lindley*).

Infusion of Blood-root. *Syn.* INFUSION OF PUCCOON; INFUSUM SANGUINARIÆ, L. *Prep.* Blood-root (*Sanguinaria canadensis*), ½ oz.; boiling water, 1 pint. Stimulant and emetic.

Infusion of Blue Flag. *Syn.* INFUSUM IRIDIS VERSICOLORIS, L. *Prep.* 1. From the flowers of blue flag (*Iris versicolor*). 2. From the root of rhizomes. The first is used chiefly for its rich colour, as a test, &c.; the second is diuretic and cathartic, and apt to produce distressing nausea and prostration.

Infusion of Bone'set. *Syn.* INFUSUM EUPATORII, L. *Prep.* 1. (Ph. U. S.) From the dried leaves and flowers of boneset or thoroughwort (*Eupatorium perfoliatum*). Diaphoretic, nauseant, and emetic when warm; tonic when cold.

2. (Compound: INFUSUM EUPATORII COMPOSITUM, L.; *Ellis.*) Bonset and sage, of each ½ oz.; cascarilla, 1 dr.; boiling water, 1½ pints; infuse until cold and strain. In hectic fever. A wine-glassful of either of the above, given hourly, in these diseases, until perspiration and nausea are induced, has been highly recommended in influenza.

Infusion of Braz'il-wood. *Syn.* INFUSUM LIGNI BRASILINSIS, L. From ground or rasped Brazil wood. When wanted to keep, rectified spirit, 3 fl. oz., is added to every pint. Used for colouring, and as a test.

Infusion of Broom. *Syn.* INFUSUM SCOPARII, L. See DECOCTION OF BROOM.

Infusion of Bu'chu. *Syn.* INFUSUM BUCHU (B. P.), I. BUCKU (Ph. E.), I. DIOSMÆ, L. *Prep.* 1. (B. P.) From bruised buchu leaves, 1 oz.; boiling distilled water, 1 pint; infuse for ½ an hour and stain. Diuretic, sudorific, tonic; in dyspepsia, &c.; but chiefly in chronic affections of the bladder and urethra attended with copious secretion.—*Dose*, 1 to 2 oz.

2. (Compound: INFUSUM BUCHU COMPOSITUM, I. DIOSMÆ C., L.; *Radius*). Leaves of buchu and whortleberry, of each, ½ oz.; boiling water, 8 oz. (say ½ pint); digest for ½ an hour, strain, and

add of syrup of senega, ½ fl. oz.—*Dose*, 1 or 2 table-spoonfuls every hour; in atony of the bladder and mucous discharges.

Infusion of Buck'bean. *Syn.* INFUSUM MENYANTHIS, L. From the herb or root of buckbean or marsh trefoil (*Menyanthes trifoliata*). Bitter, stomachic, tonic, and diuretic; in large doses, purgative, vermifuge, and emetic. It has been recommended in agues, gout, dropsy, scurvy, worms, &c. The chief consumption of this plant is by the brewers; "2 oz. being equal to 1 lb. of hops." (*Gray.*)

Infusion of Bur'dock. *Syn.* INFUSUM BARDANÆ, L. From the root of common burdock. Aperient, diuretic, diaphoretic, and tonic; in gout, rheumatism, skin diseases, &c. See DECOCTION and EXTRACT.

Infusion of Calum'ba. *Syn.* INFUSUM CALUMBÆ (B. P.), L. *Prep.* 1. (B. P.) Calumba, in coarse powder, 1 oz.; cold distilled water, 20 oz.; macerate ½ hour and strain. Infusion of calumba is a good tonic and stomachic bitter.—*Dose,* 1 to 3 fl. oz.; in dyspepsia, &c., and for restraining vomiting and diarrhœa during pregnancy or dentition. It is preferably joined with small doses of the carbonates of soda, potassa, ammonia, or magnesia, when there is acidity; or with chalybeates, when there is paleness and a low pulse; with all of which substances it may be mixed without suffering any sensible alteration.

2. (Concentrated: INFUSUM CALUMBÆ CONCENTRATUM, L.) *a.* Calumba, in coarse powder, 5½ oz.; cold distilled water 12 fl. oz.; digest with frequent agitation, for 3 or 4 hours, then express the liquor, and repeat the digestion with 5½ fl. oz more of tepid water; after another hour, express this portion also, using as much force as possible; next mix the liquors, heat them quickly to the boiling-point in a shallow vessel, and pour the infusion, whilst still hot, into a strong bottle, and when it has cooled a little add of rectified spirit, 4 fl. oz., secure down the stopper or cork, and agitate well for a few minutes. The bottle must now be set aside for a week, after which the clear portion is to be decanted from the dregs. Very superior.

b. (Wholesale.) From calumba (reduced to coarse powder), 5¼ lbs.; rectified spirit, 5 pints; (diluted with) water, 12 pints; digest for a week, or precede by displacement. Should there be any difficulty in obtaining it free from cloudiness, the whites of 4 or 5 eggs, previously mixed with about ¼ pint of cold water, may be added to the infusion, which, after being well agitated for about 10 minutes, must be allowed to repose for 7 or 8 days, and then decanted from the dregs. Should it not be perfectly transparent, it may be filtered through blotting-paper.—*Prod.*, 20 lbs.

Obs. The concentrated infusion produced by the above formulæ is of very superior quality, and has acquired an extensive sale in the wholesale trade. 1 part added to 5¼ parts of water makes a perfectly transparent liquid, possessing exactly similar virtues to the INFUSION OF CALUMBA (B. P.).

Infusion of Canthar'ides. *Syn.* INFUSION OF SPANISH FLIES; INFUSUM CANTHARIDIS, I. LYTTÆ, L. *Prep.* (*Soubeiran.*) Spanish flies (powdered), 20 gr.; boiling water, q. s. (about 3½ fl. oz.) to yield 3 fl. oz., after expression and filtration.

Infusion of Cap'sicum. *Syn.* INFUSUM CAPSICI, L. *Prep.* 1. (*Pereira.*) Capsicum (powdered), ½ oz.; boiling water, 1 pint.—*Dose,* ½ fl. oz.

2. (*Stephen's* 'PEPPER MEDICINE'; *Pereira.*) Red pepper (*Capsicum fructescens*), 2 tablespoonfuls (or 3 of cayenne pepper); common salt, 2 teaspoonfuls; boiling water, ½ pint; to the strained liquor, when cold, add of very sharp vinegar, ½ pint.—*Dose,* 1 tablespoonful, slowly swallowed, every ½ hour, in cholera, malignant sore throat, scarlatina, &c.

Infusion of Car'away. *Syn.* CARAWAY TEA; INFUSUM CARUI, L. *Prep.* From bruised caraway seed, 3 dr.; boiling water, 1 pint. In the flatulent colic of infants, and as an adjunct to aperient medicine.

Infusion of Carrot Seed. *Syn.* INFUSUM DAUCI, I. CAROTÆ, L. Diuretic; in dropsy and nephritic complaints; ½ to 1 pint being taken daily.

Infusion of Cascaril'la. *Syn.* INFUSUM CASCARILLÆ (B. P.), L. *Prep.* 1. (B. P.) Cascarilla, in coarse powder, 1 oz.; boiling distilled water, 10 oz.; infuse for ½ hour in a closed vessel and strain.—*Dose,* 1 to 2 oz., usually combined with carbonate of soda and tincture of cascarilla. It is an excellent medicine in dyspepsia, debility, diarrhœa, &c.

2. (Concentrated: INFUSUM CASCARILLÆ CONCENTRATUM, L.) *a.* Cascarilla (good and fragrant, bruised), 6½ lbs.; rectified spirit of wine, 3 pints; cold water, 6 pints; macerate in a close vessel for 14 days, express the liquor, and filter.

b. As the last, but proceeding by the process of percolation.

Obs. If the preceding processes are well managed, the product is 10 lbs., and resembles brandy in colour and transparency, and is delightfully fragrant. 1 part of this infusion mixed with 6½ parts of water makes a preparation exactly resembling the INFUSION OF CALUMBA (B. P.)

Infusion of Cas'sia. *Syn.* CASSIA TEA; INFUSUM CASSIA FISTULÆ, L.; EAU DE CASSE, Fr. *Prep.* (*Soubeiran.*) Cassia pods (bruised), 4 oz.; boiling water, 1½ pints. Laxative.

Infusion of Cate'chu. *Syn.* COMPOUND INFUSION OF CATECHU; INFUSUM CATECHU (B. P.). L. *Prep.* (B. P.) Catechu in coarse powder, 160 gr.; cinnamon, bruised, 30 gr.; boiling water, 10 oz ; macerate for ½ an hour in a covered vessel and strain. Astringent in diarrhœa.—*Dose,* 1 to 2 oz. three or four times a day, or after every liquid dejection.

Infusion of Catmint. *Syn.* INFUSUM CATARIÆ. *Prep.* Dry catmint, 2 oz.; boiling water, 1 pint.

Infusion of Cayenne Pep'per. See INFUSION OF CAPSICUM.

Infusion of Cen'taury. *Syn.* INFUSUM CENTAURI, L. From the flowering tops of common or lesser centaury (*Erythræa centaurium*). Bitter, febrifuge, stomachic, and vermifuge. A popular remedy in obstructions, jaundice, debility, dyspepsia, &c.; and externally, for the itch, and to destroy pediculi. An infusion is also made of the root, which is about one half more powerful than the tops. The plant is "a valuable native

medicine; in the places where it grows it is carefully collected for use in rustic pharmacy" (*Lindley*).

Infusion, Cephal'ic. *Syn.* INFUSUM CEPHALICUM, L. *Prep.* (Edin. Hosp.) Valerian root, 2 oz.; rosemary tops, 4 dr.; boiling water, 1 quart; infuse 12 hours, strain, and add aromatic water, 4 fl. oz. As an antispasmodic, and in various affections of the head.

Infusion of Cham'omile. *Syn.* CHAMOMILE TEA; INFUSUM ANTHEMIDIS (B. P.) I. CHAMÆMELI, L. *Prep.* 1. (B. P.) Chamomile flowers, ½ oz.; boiling water, 10 oz.; infuse for 15 minutes, and strain. Tonic, bitter, and stomachic; also emetic. It should be drunk cold, as it is emetic when warm. —*Dose.* As a stomachic, 1 to 3 oz.; as an emetic, 5 to 10 oz.

2. (Concentrated: INFUSUM ANTHEMIDIS CONCENTRATUM, L.) From chamomiles, 5½ oz.; water, 1 pint; boil till the mixture weighs exactly 21 oz., express the liquor by means of a powerful tincture-press, cool, and add of essential oil of chamomile, 15 drops, dissolved in rectified spirit, 5 fl. oz.; agitate well, let it repose until the next day, then decant the clear, and filter. Strongly bitter and odorous, and beautifully transparent. 5½ times as strong as the ordinary infusion (B. P.).

Infusion of Chamomile and Orange. *Syn.* INFUSUM ANTHEMIDIS ET AURANTII. *Prep.* (*Dr Percival.*) Chamomile flowers, 1 oz.; dried orange peel, ½ oz.; cold water, 3 lbs.; macerate for 24 hours.

Infusion of Cher'ry-laurel. *Syn.* INFUSUM LAURO-CERASI, L. *Prep.* (*Dr Cheston.*) Fresh leaves of the common or cherry-laurel (*Cerasus lauro-cerasus*), 2½ oz.; boiling water, 1 pint; infuse, strain, and add of clarified honey, 2½ oz. As a lotion in cancer of the lip, and as a wash for malignant ulcers.

Infusion of Chiret'ta. *Syn.* INFUSUM CHIRATÆ, L. *Prep.* 1. (B. P.) Chiretta, cut small, 1 oz.; distilled water, at 120° F., 40 oz.; infuse half an hour and strain.—*Dose*, 1 to 2 oz.

Obs. Chiretta is a pure tonic bitter, closely allied to gentian, and has been long esteemed in the East Indies as a remedy for acidity, flatulence, and dyspepsia, especially when occurring in gouty or debilitated habits. It is usually given in combination with carbonate of soda or salts of iron. The whole of the plant is employed.

2. (Concentrated: INFUSUM CHIRETTÆ CONCENTRATUM, L.). From chiretta, 4 oz.; for each pint of the product; prepared as either CONC. INFUSION OF CALUMBA or CASCARILLA. Eight times as strong as the common infusion.

Obs. Infusion of bark is tonic and stomachic, and in very large doses febrifuge. It is an extremely useful medicine in dyspepsia, debility, and during convalescence, and is often a valuable adjunct to more active remedies. Like the decoction, it is most energetic when strained whilst hot. The addition of 1 fl. dr. of diluted sulphuric acid to the water before pouring it on the bark increases its solvent power, and consequently the strength of the infusion.—*Dose*, 1 to 3 fl. oz.

2. (Concentrated: INFUSUM CINCHONÆ CONCENTRATUM, L.) *a.* Yellow bark (coarsely powdered), 4 lbs.; boiling water, 8 lbs.; digest for 12 hours, express the liquid, add rectified spirit, 2 lbs., and after 24 hours' repose decant the clear portion.

b. Yellow bark (in coarse powder), 4 lbs.; cold water, 8 lbs.; rectified spirit, 2 lbs.; dilute sulphuric acid, 4 fl. oz.; mix the fluids, and either macerate the bark in them for a week in a closed vessel, or proceed by the method of displacement. Very superior.

Obs. 1 fl. dr. of either of the above, added to 7 fl. dr. of water, produces an extemporaneous infusion of cinchona resembling that of the pharmacopœia. The concentrated preparation of the Ph. L., being more than 8 times the usual strength, is placed amongst LIQUORS.

3. From PALE BARK. *a.* (Ph. L.) INFUSION OF PALE CINCHONA; INFUSUM CINCHONÆ PALLIDÆ (Ph. L.). From pale bark, as INFUSION OF CINCHONA (Ph. L.).

b. (Ph. D.) INFUSUM CINCHONÆ (Ph. D.). Crown or pale bark, 1 oz.; boiling water, ½ pint; infuse 1 hour in a covered vessel, and strain through paper.

Obs. "This infusion is inferior to the preceding" (from yellow bark) "in activity, and is a very unnecessary one. It is said to oppress the stomach less than that of the other cinchona bark; the reason is obvious—it is weaker" (*Pereira*).

c. (Concentrated: INFUSUM CINCHONÆ PALLIDÆ CONCENTRATUM, L. As CONCENTRATED INFUSION OF CINCHONA, but using pale bark. The concentrated preparation of the Ph. L. will be found under LIQUORS.

Infusion of Cin'namon. *Syn.* CINNAMON TEA; INFUSUM CINNAMOMI, L. In flatulence, dyspepsia, and nervous colics.

Infusion of Cloves. *Syn.* CLOVE TEA; INFUSUM CARYOPHYLLORUM, I. CARYOPHYLLI (B. P.), L. *Prep.* 1. (B. P.) Cloves (bruised), 1 oz.; boiling distilled water, 40 oz.; infuse for half an hour and strain. Aromatic, stimulant, and stomachic, either alone or in combination; in colic, dyspepsia, gout, &c.—*Dose*, 1 to 2 oz.

2. (Concentrated: INFUSUM CARYOPHYLLI CONCENTRATUM, L.) *a.* Bruised cloves, 3 oz.; boiling water, 16 fl. oz.; infuse as above and strain; when cold add of rectified spirit ¼ pint, and filter.

b. Bruised cloves, 1⅝ lbs.; rectified spirit, 1 quart; cold water, 3 quarts; macerate for 7 days, and express the liquid; sprinkle the marc with water, 12 fl. oz., and after the lapse of an hour again submit it to the press; lastly, filter the mixed liquors. Very fine. The above are about 8 times the strength of the INFUSION OF CLOVES (Ph. L.).

Infusion of Cof'fee. *Syn.* INFUSUM CAFFEI, L. *Prep.* (*Dr McBride.*) Unroasted coffee berries (bruised), 30 in number; cold water, 1 quart; macerate 2 or 3 hours. In calculus, &c.—*Dose*, ½ pint every morning.

Obs. Sir J. Floyer and Sir J. Pringle cured asthma with a strong solution of roasted coffee. M. Bouchardat prescribes a strong infusion made by displacement (percolation), and mixed with a little brandy, in poisoning by opium and other like narcotics, after the administration of emetics

and iodurated water. M. Honore also employs very strong-made coffee in albuminuria. Clausen gives it in gout, and Parker employs it as a nervous stimulant in lieu of ammonia and wine, for persons of a slightly sensitive and excitable temperament.

Infusion of Contrayer'va. *Syn.* INFUSUM CONTRAYERVÆ, L. *Prep.* (*Pereira.*) Contrayerva (in powder), 1 oz.; boiling water, 12 fl. oz. Stimulant, tonic, and diaphoretic; in low fevers, &c.

Infusion of Copal'che Bark. *Syn.* INFUSUM COPALCHI CORTICIS, L. *Prep.* (*Dr Stark.*) Bark of Copalche bush *Croton pseudo-China*), ½ oz.; boiling water, 1 pint; digest 2 hours, and strain. A warm bitter and stomachic.

Infusion of Cor'sican Moss. *Syn.* INFUSUM HELMINTHOCORTI, L. *Prep.* (*Farr.*) Corsican moss, 5 dr., boiling water, 1 pint; macerate for 10 or 12 hours, and strain. *Ad libitum* in cancer. See DECOCTION.

Infusion of Cuspa''ria. *Syn.* INFUSION OF ANGOSTURA BARK; INFUSUM CUSPARLÆ (B. P.), I. ANGUSTURÆ, L. *Prep.* (B. P.) Cusparia, in coarse powder, 1 oz.; distilled water, at 120°, 20 oz.; infuse 2 hours, and strain. Stimulant and tonic; in typhus fever, bilious diarrhœa, dysentery, &c.

Infusion of Daf''fodil. *Syn.* INFUSUM NARCISSI PSEUDO-NARCISSI, L. *Prep.* (*Dufresnoy.*) Flowers of daffodil (*Narcissus pseudo-narcissus*), 3 to 16 in number; boiling water, 1 pint. Expectorant, nauseant, and emetic. In hooping-cough.

Infusion of Dah''lia Pe'tals. From the violet or blue varieties. Used for its colour and as a test.

Infusion of Dandeli'on. *Syn.* INFUSION OF TARAXACUM; INFUSUM TARAXACI, L. *Prep.* 1. From the sliced root. Stimulant, resolvent, and tonic.

2. (Concentrated: INFUSUM TARAXACI CONCENTRATUM, L.) From the root (sliced), 1 lb.; exposed to a current of warm dry air until crisp, then coarsely pulverised, and digested for a week in a mixture of rectified spirit, 12 fl. oz.; cold water, 1½ pints. 8 times the usual strength.

3. (Compound: INFUSUM TARAXACI COMPOSITUM, L.; *Meigs.*) Infusion of dandelion, 4 fl. oz.; extract of do., 2 dr.; sesquicarbonate of soda, ½ dr.; tartrate of potassa, 3 dr.; tincture of rhubarb, 3 fl. dr.; tincture of henbane, 20 drops. In dropsical and visceral affections.—*Dose*, 1-3rd part thrice daily. See DECOCTION, EXTRACT, &c.

Infusion of Digita'lis. See INFUSION OF FOXGLOVE.

Infusion, Diuret'ic. *Syn.* INFUSUM DIURETICUM, L. *Prep.* 1. Broom-tops, 1 oz.; boiling water, 1 pint; infuse 1 hour, strain, cool, and add of sweet spirits of nitre, 3 fl. dr.—*Dose.* A wine-glassful every other hour.

2. Infusion of foxglove, 1 fl. oz.; tincture of foxglove, ½ fl. dr.; acetate of potassa, 1 dr.; laudanum, 10 drops.—*Dose*, 1 table-spoonful twice or thrice a day, carefully watching the effects.

3. Juniper berries, 2 oz.; aniseed, ¼ oz.; boiling water, 1 pint; infuse 1 hour; strain, and when cold, add of compound spirit of juniper, 2 fl. oz.; tincture of squills, 1 fl. dr.; nitre, 1 dr.—*Dose*, ½ a teacupful frequently. All the above are used as diuretics in dropsy. See INFUSIONS OF BROOM, FOXGLOVE, and JUNIPER.

Infusion of Dog'wood. *Syn.* INFUSUM CORNUS FLORIDÆ, L. From the bark of American dogwood (*Cornus florida*). See DECOCTION.

Infusion of Dulcamara (B. P.). *Syn.* INFUSUM DULCAMARÆ. *Prep.* Infuse bruised dulcamara, 1 oz.; in 10 fl. oz. of boiling water in a covered vessel for 1 hour and strain.—*Dose*, 1 oz. to 2 oz.

Infusion of El'der Flowers. *Syn.* ELDER-FLOWER TEA; INFUSUM SAMBUCI FLORUM, L. From the picked flowers, ½ oz.; boiling water, 1 pint. Pectoral, expectorant, and diaphoretic, either alone or sweetened with honey.

Infusion of Elecampane. *Syn.* INFUSUM INULÆ. *Prep.* Elecampane root, 5 dr.; boiling water, 1 pint; infuse for 2 hours and strain.

Infusion of Elm-bark. *Syn.* COMPOUND INULÆ, L. Diaphoretic, expectorant, and tonic. FUSION OF ELM-BARK; INFUSUM ULMI COMPOSITUM, L. *Prep.* (*Cadet.*) Elm-bark, bitter-sweet, burdock, and fumitory, of each, 2 dr.; boiling water, 1 pint; digest for 4 hours, strain, and add of syrup of sarsaparilla, 1 oz. The whole to be taken in 24 hours, in divided doses in the chronic exanthemata. See DECOCTION.

Infusion of Er'got of Rye. *Syn.* INFUSUM ERGOTÆ (B. P.), L. *Prep.* 1. (B. P.) Ergot, in coarse powder, 1 oz.; boiling distilled water, 40 oz.; infuse ½ an hour in a covered vessel and strain. Should be made fresh when required.—*Dose*, 1 to 2 oz. every ½ hour or hour, as a parturient. Also as an injection for gleet.

2. (Concentrated.) See LIQUOR OF ERGOT.

Infusion of Eucalyptus. (*Griffiths.*) *Syn.* INFUSUM EUCALYPTI GLOBULI. *Prep.* Cut leaves of Eucalyptus globulus, 2 dr.; boiling water, 4 oz.; infuse and strain. Take morning and evening.

Infusion of Fen'nel. *Syn.* FENNEL TEA; INFUSUM FŒNICULI, L. *Prep.* From sweet fennel-seeds, ½ oz.; boiling water, 1 pint. In griping and windy colic of infants; a few drops to ½ a teaspoonful for a dose, or a little by way of enema.

Infusion of Flax-seed. See INFUSION OF LINSEED.

Infusion of Fleabane. *Syn.* INFUSUM ERIGEROMIS CANADENSIS. *Prep.* Canadian fleabane, 1 oz.; boiling water, 16 oz. Diuretic and astringent.

Infusion of Fox'glove. *Syn.* INFUSUM DIGITALIS (B. P.), L. *Prep.* 1. (B. P.). Digitalis, dried, 28 gr.; distilled water, 10 oz; infuse ¼ hour and strain.—*Dose*, ¼ to ½ oz.

2. (Ph. E.) Foxglove (dried), 2 dr.; boiling water, 18 fl. oz.; spirit of cinnamon, 2 fl. oz.

3. (Ph. D.) Foxglove (dried and reduced to a coarse powder), 1 dr.; boiling water, 9 fl. oz.; infuse 1 hour. The product should measure about 8 fl. oz. The last two are of double the strength of the infusion Ph. L., and the dose must consequently be only 2 to 4 fl. dr. "I believe this, when properly made, to be the most effectual of the preparations of foxglove (*Pereira*)." See FOXGLOVE.

Infusion of Fu'mitory. *Syn.* INFUSUM FUMARIÆ, L. From the herbaceous portion of common fumitory (*Fumaria officinalis*). Aperient and diaphoretic; in obstinate skin diseases and chronic obstructions of the liver.

Infusion of Galls. *Syn.* INFUSUM GALLÆ, L. *Prep.* 1. From Aleppo galls, coarsely powdered. In diarrhœa, hæmorrhages, &c.; also freely, in cases of poisoning by the alkaloids; and diluted with 3 or 4 times its volume of water, for injections, embrocations, gargles, &c.

2. (Compound: INFUSUM GALLÆ COMPOSITUM, MISTURA GALLÆ, L.; *Ellis.*) Infusion of galls, 4 fl. oz.; prepared chalk, ½ oz.; powdered gum, 1 dr.; tincture of opium, ½ fl. dr.—*Dose,* 1 tablespoonful every 2 hours, in diarrhœa, &c.

Infusion of Gar'lic. *Syn.* INFUSUM ALLII, L. *Prep.* (*White.*) Garlic (recent), ½ lb.; water, 4 lbs.; place them in a covered pot, set it in a very slow oven for 3 or 4 hours, and when oold, express the fluid portion.—*Dose.* In epilepsy, 2 teaspoonfuls before and after every meal; in chronic diarrhœa, a teaspoonful after every motion.

Infusion of Gen'tian. *Syn.* INFUSUM GENTIANÆ, L. *Prep.* 1. (*Beral.*) Gentian (bruised), 2 dr.; boiling water, 1 pint; infuse 5 or 6 hours and strain. Stomachic.

2. (Compound: INFUSUM GENTIANÆ COMPOSITUM; B. P.)

Prep. a. (B. P.) Gentian, sliced, 1 oz.; orange peel, cut small, 1 oz.; lemon peel (fresh), 2 oz.; boiling distilled water, 4 pints; infuse for ½ an hour in a covered vessel, and strain.—*Dose,* 1 to 2 oz.

b. (Ph. E.) Sliced gentian root, ½ oz.; bitter orange peel (dried and bruised) and coriander seeds, of each, 1 dr.; proof spirit, 4 fl. oz.; digest for 3 hours, then add of cold water, 16 fl. oz., and in 12 hours more strain.

c. (Ph. D.) Gentian and dried orange peel, of each, 2 dr.; boiling water, ½ pint; macerate 1 hour and strain.—*Dose* of the last two, ½ to 1 fl. oz.

3. (Concentrated Compound: INFUSUM GENTIANÆ COMP. CONCENTRATUM, L.) *a.* Gentian root (bruised), 4½ lbs.; boiling water, q. s. to cover it; infuse with occasional agitation for 2 hours, express the liquor, wash the marc with a little boiling water, and evaporate to 13 quarts; when cold, strain through flannel, add of rectified spirit, 1 gall., and pour the mixed fluids on dried orange peel, 4½ lbs., and fresh lemon peel, 9 lbs.; macerate for 1 week, then express the liquor in a powerful press, and filter through paper.

b. Gentian and dried orange peel, of each, 4½ lbs.; fresh lemon peel, 9 lbs.; cold distilled water, 13 quarts; rectified spirit, 1 gall.; macerate for 14 or 15 days, with frequent agitation, then express the liquid, add 1 dr. each of the essential oils of lemon and orange, agitate well, and filter through paper.

c. Gentian, 1¼ lbs.; essence of lemon, 1 dr.; essence of orange, ½ dr.; essence of cedrate, 15 drops; rectified spirit, 1 quart; cold water, 3 quarts; digest for 10 days and filter.

4. (With RHUBARB: INFUSUM GENTIANÆ ET RHEI, MISTURA STOMACHICA, L.) From gentian and rhubarb (bruised), of each, 2 dr.; boiling water, 1 pint; digest 1 hour and strain; to the cold infusion add of sesquicarbonate of ammonia, 1 dr. An admirable medicine in dyspepsia, hysteria, loss of appetite constipation, chronic rheumatism, &c.

Infusion of Gin'ger. *Syn.* GINGER TEA; INFUSUM ZINGIBERIS, L. From the best unbleached Jamaica ginger, freshly bruised or grated. In flatulence, colic, and indigestion.

Infusion of Gin'seng. *Syn.* GINSENG TEA; INFUSUM GINSENG, I. RADICIS G., L. *Prep.* Ginseng (the root of *Panax Schinseng*), ½ oz.; ginger (grated), 1 dr.; boiling water, 1 pint; macerate 1 hour, then add of cinnamon (bruised), ½ dr.; infuse for another hour and strain. Ginseng tea, made according to the above formula, has a wonderful reputation in China as a stimulant, restorative, and aphrodisiac. In Europe, however, it is merely regarded as an aromatic demulcent.

Obs. American ginseng (the root of *Panax quinquefolium*) may be substituted for the Asiatic product.

Infusion of Gold'thread. *Syn.* INFUSUM COPTIS, L. From the root of *Coptis trifolia.* Bitter, stomachic; in dyspepsia, and as a mouthwash in thrush.

Infusion of Gua'co. *Syn.* INFUSUM GUACO, L. From the bruised leaves and stems of guaco or huaco (*Mikania guaco*). Sudorific and vulnerary; reputed in South America to be a powerful remedy for the bites of venomous serpents and for hydrophobia, but the trials in this country do not show it to be of any value in such cases.

Infusion of Guaiac'um. *Syn.* COMPOUND INFUSION OF GUAIACUM, I. OF THE WOODS; INFUSUM GUAIACI COMPOSITUM, AQUA BENEDICTA COMPOSITA, L. *Prep.* (Ph. D., 1826.) Guaiacum shavings, 6 oz.; bruised liquorice root, 1 oz.; sassafras bark, ½ oz.; coriander seeds, 3 dr.; lime water, 96 fl. oz. (say 5 pints); infuse for 2 days, and strain. *Dose,* 3 to 4 fl. oz., twice or thrice a day, in scrofula, rheumatism, gout, eruptions, &c.

Infusion of Gum. *Syn.* INFUSUM ACACIÆ, L. From gum-acacia and lump sugar, of each, 2 oz.; boiling water, 1 pint; macerate until dissolved, then cool, and add of orange-flower water, ½ fl. oz. A pleasant demulcent in coughs, hoarseness, &c.

Infusion of Hedge Hys'sop. *Syn.* INFUSUM GRATIOLÆ, L. *Prep.* (*A. T. Thomson.*) Hedge hyssop (*Gratiola officinalis*), dried, 2 dr.; boiling water, 8 fl. oz. Cathartic, diuretic, emetic, and vermifuge.—*Dose,* 3 to 6 fl. dr.; in dropsies, gout, jaundice, &c. See EXTRACT.

Infusion of Hem'lock. *Syn.* INFUSUM CONII. I. CONII MACULATI, L. *Prep.* (Guy's Hosp.), Dried leaves of hemlock and coriander seeds, of each, 2 dr.; boiling water, 8 oz.; infuse for 2 hours. Combined with acetate of ammonia, tincture of henbane, and syrup of poppies, in pulmonary complaints, &c.

Infusion of Henbane. *Syn.* INFUSUM HYOSCYAMI, L. *Prep.* 1. From fresh leaves, ½ oz.; boiling water, 1 pint. As a lotion for painful ulcers, swelled face, &c.

2. (Compound: HENBANE FOMENTATION; INFUSUM HYOSCYAMI COMPOSITUM, L. (*Radius.*)

Henbane leaves, poppy heads, and mallows, of each, 1 oz.; boiling water, 2 quarts. For painful ulcers and in facial neuralgia, &c.

Infusion of Hops. *Syn.* HOP TEA; INFUSUM HUMULI, I. LUPULI (B. P.), L. *Prep.* (Ph. L.). Hops, 1 oz.; boiling distilled water, 1 pint; macerate for 1 hour in a covered vessel (press) and strain. Tonic and anodyne. Well-hopped mild ale is a good substitute.

Infusion of Hore'hound. *Syn.* HOREHOUND TEA; INFUSUM MARRUBII, L. From the leaves; demulcent, pectoral; a popular remedy in coughs, colds, hoarseness, and chest affections generally, taken freely.

Infusion of Horserad'ish. *Syn.* INFUSUM ARMORACIÆ, L. *Prep.* 1. From horseradish alone. Diuretic and stomachic.

2. (Compound: INFUSUM ARMORACIÆ COMPOSITUM, L.; Ph. L.) Horseradish (sliced) and mustard seed (bruised), of each, 1 oz.; boiling distilled water, 1 pint; macerate for 2 hours in a covered vessel, strain, and add of compound spirit of horseradish, 1 fl. oz. Stimulant, stomachic, and diuretic; in dropsies, paralysis, scurvy, chronic rheumatism, &c.

Infusion of Hys'sop. *Syn.* HYSSOP TEA; INFUSUM HYSSOPI, L. *Prep.* 1. From the leaves of *Hyssopus officinalis*, Linn. Stimulant, stomachic, emmenagogue, and expectorant; in dyspepsia, flatulency, hysterical affections, &c.; also used by boxers as a wash for black eyes.

2. (Compound: INFUSUM HYSSOPI COMPOSITUM, L.; *Ratier.*) Hyssop leaves, 2½ dr.; liquorice, 2 dr.; boiling water, 1 quart. As a demulcent drink in catarrhal affections.

Infusion of Indian Sarsapari'lla. *Syn.* INFUSUM HEMIDESMI, L. From Indian or scented sarsaparilla (*Hemidesmus indicus.*) Dr Ashburner orders it to be made with lime-water (cold); but this plan is seldom followed.—*Dose* and *uses*, same as those of infusion of sarsaparilla.

Infusion of I'ron (Bitter). *Syn.* INFUSUM FERRI AMARUM, L. *Prep.* (*Dr R. E. Griffith.*) Iron filings, 3 oz.; gentian and ginger, of each, bruised, 1 oz.; orange peel, ½ oz.; strong old cider, 1 pint; infuse for a month, frequently stirring, and filter.—*Dose,* ½ to 1 dr., 3 or 4 times daily, as a chalybeate tonic.

Infusion of Ju'niper. *Syn.* INFUSUM JUNIPERI, I. BACCÆ J., L. *Prep.* 1. From the berries alone. As a stimulant diuretic in dropsies, &c.

2. (Compound: INFUSUM JUNIPERI COMPOSITUM, L.) *a.* (Guy's Hosp.) Juniper berries, 2½ oz.; boiling water, 1 pint; to the strained solution, when cold, add, of compound spirit of juniper, 10 fl. dr.; bitartrate of potassa, 1 dr.

b. (*Parrish.*) Ginger, juniper berries, and mustard, of each, bruised, ½ oz.; horseradish and parsley root, of each, bruised, 1 oz.; cider, 1 quart; infuse, and strain with expression. All the above are used in dropsies.

Infusion of Justitia. *Syn.* INFUSUM JUSTICIÆ. *Prep.* Root of painted justicia, 2 dr.; boiling water, 1 pint; infuse for 1 hour.

Infusion of Ki'no. *Syn.* INFUSUM KINO, L. From kino, 5 dr.; boiling water, 1 pint. In diarrhœa, and diluted with 4 or 5 times its bulk of water as an injection in chronic gonorrhœa.

Infusion of Kousso (B. P.). *Syn.* INFUSUM CUSSO, L. *Prep.* Infuse kousso in fine powder, ½ oz.; in boiling distilled water 8 fl. oz., in a covered vessel for 15 minutes. Must not be strained.

Infusion of Lime Flowers. *Syn.* LINDEN-FLOWER TEA; INFUSUM TILLÆ, L. *Prep.* 1. From the flowers of the lime or linden tree (*Tilia europæa*). Antispasmodic, diaphoretic, and cephalic.

2. (Compound: INFUSUM TILLÆ COMPOSITUM, L.; *Foy.*) Chamomiles, linden flowers, and orange leaves, of each, 2 dr.; boiling water, 1 quart; infuse, strain, and add of syrup, 2 fl. oz. In nervous headaches, &c. The above are much used on the Continent.

Infusion of Lin'seed. *Syn.* LINSEED TEA, FLAXSEED T.; INFUSUM LINI (B. P.), L. *Prep.* (B. P.) Linseed (bruised), 150 gr.; dried liquorice root (sliced), 50 gr.; boiling distilled water, 10 oz.; infuse for 2 hours and strain. A cheap and useful demulcent in pulmonary and urinary irritation; especially in catarrhs, gonorrhœa, &c.; *ad libitum.* Dr Pereira recommends the addition of sliced lemon and sugar-candy, to render it more palatable. See DECOCTION.

Infusion of Liq'uorice. *Syn.* INFUSUM GLYCYRRHIZÆ, L. From the fresh root, sliced. Demulcent and laxative; taken *ad libitum.*

Infusion of Lit'mus. *Syn.* INFUSUM LACMI, L. Used for its colour and as a liquid test, and to make test-paper.

Infusion of Lobe'lia. *Syn.* INFUSUM LOBELIÆ, I. L. INFLATÆ. From lobelia or Indian tobacco. In asthmas chiefly.—*Dose,* 1 to 2 table-spoonfuls every ½ hour until it occasions nausea.

Infusion of Log'wood. *Syn.* LOGWOOD TEA; INFUSUM HÆMATOXYLI, L. From logwood chips. One of the best remedies known for simple diarrhœa arising from weakness; also used as a colour and test. See DECOCTION, EXTRACT, &c.

Infusion of Maidenhair. *Syn.* INFUSUM ADIANTI, L. From either common maidenhair *Adiantum capillus veneris*), or Canadian maidenhair (*Adiantum pedatum*). They are both slightly bitter, aromatic, and pectoral. The infusion forms an excellent demulcent drink in catarrhs.

Infusion of Malam'bo Bark. *Syn.* INFUSUM CORTICUS MALAMBO, L. *Prep.* (*Ure.*) Bark (from *Croton malambo*), 2 dr.; boiling water, 1 pint, An aromatic tonic and astringent.

Infusion of Mallow Flowers. *Syn.* INFUSUM MALVÆ FLORUM, L. Pectoral and laxative. Chiefly used as a test.

Infusion of Malt. *Syn.* MALT TEA, SWEET WORT; INFUSUM BYNES, I. MALTI, L. Prepared with hot water (165°—170° F.). Demulcent and laxative. A useful drink in sore throat, inflammatory fevers, &c. Some persons flavour it with sliced lemon.

Infusion of Ma''rygold. *Syn.* INFUSUM CALENDULÆ, L. From the flowers of the common marygold (*Calendula officinalis*). Carminative, diaphoretic, and emmenagogue. It has been recently recommended in cancerous affections, both internally and as a lotion. Radius adds syrup of orange peel to flavour it.

Infusion of Mat'ico. *Syn.* INFUSUM MATICONIS, I. MATICÆ, I. MATICO, L. *Prep.* 1. From the leaves of the matico plant (*Artanthe elongata*). Aromatic, bitter, stimulant, and reputed hæmo-

static; in internal hæmorrhages and mucous discharges. The Indians of South America use it as an aphrodisiac (*Martius*).

2. (Compound: INFUSUM MATICONIS COMPOSITUM, L.; *Watmough*.) Matico and senna, of each, 2 dr.; boiling water, 1 pint. In hæmorrhagic and other discharges, piles, &c.; a wine-glassful repeatedly.

Infusion of Mayweed. *Syn.* INFUSUM COTULÆ, L. From the dried flowers of mayweed or stinking chamomile (*Anthemis cotula*). Bitter, stomachic, and diaphoretic; in large doses, emetic and sudorific; chiefly in hysterical affections, scrofula, &c.

Infusion of Mea'dow-rue. *Syn.* INFUSUM THALICTRI FLAVI, L. From the herb meadow-rue (*Thalictrum flavum*). In hydrophobia, taken plentifully.

Infusion of Mil'foil. *Syn.* YARROW TEA; INFUSUM MILLEFOLII, L. In dropsies, and as a fomentation to bruises, &c. See EXTRACT, &c.

Infusion of Mint. *Syn.* MINT TEA. *Prep.* 1. (Ph. D.: INFUSUM MENTHÆ SIMPLEX.) From the dried leaves of green or spearmint. Carminative and stomachic; chiefly used as a vehicle for other medicines. A wine-glassful *ad libitum*.

2. (Compound: INFUSUM MENTHÆ COMPOSITUM.) To mint tea, 6 fl. oz., add of oil of spearmint, 3 drops, previously triturated with lump sugar, 2 dr., and dissolved in compound tincture of cardamoms, ½ fl. oz. A useful remedy in colic, flatulence, &c.; as the last.

Infusion of Mu'dar. *Syn.* INFUSION OF MUDAR-BARK; INFUSUM CORTICIS MUDARIS, L. From the root bark of *Calotropis gigantea*. Resembles infusion of ipecacuanha.—*Dose*, 1 to 3 teaspoonfuls, as an alterative; a wine-glassful as an emetic. In the East Indies it is highly esteemed in epilepsy, hysteria, syphilis, convulsions, and various spasmodic diseases.

Infusion of Net'tle-seed. *Syn.* INFUSUM URTICÆ SEMINUM, L. *Prep.* (*Garde.*) Seed of common nettle (*Urtica dioica*), 2½ dr.; boiling water, 18 fl. oz.; infuse 3 hours, strain, and add of syrup, 2 fl. oz. Astringent, diuretic, and pectoral.

Infusion of Or'ange Peel. *Syn.* INFUSUM AURANTII, B. P. *Prep.* 1. Dried bitter orange peel, cut small, 1 oz.; boiling water, 20 oz.; infuse for 15 minutes and strain.—*Dose*, 1 to 2 oz. Bitter and stomachic.

2. (Compound: INFUSUM AURANTII, Ph. E.; I. A. COMPOSITUM, Ph. L. & D., L.) *a.* (Ph. L. & E.) Dried bitter orange peel, ½ oz.; fresh lemon peel, 2 dr.; cloves (bruised), 1 dr.; boiling distilled water, 1 pint; macerate for 15 minutes in a covered vessel and strain.

b. (Ph. D.) Dried orange peel, 3 dr.; cloves, ½ dr.; boiling water, ½ pint; macerate half an hour. An agreeable stomachic. It is chiefly employed as a vehicle for other medicines.

c. (B. P.) Dried bitter orange peel, cut small, ½ oz.; fresh lemon peel, 120 gr.; cloves (bruised), 60 gr.; boiling water, 20 oz. Infuse for 15 minutes, and strain.—*Dose*, 1 to 2 oz.

3. (Concentrated compound: INFUSUM AURANTII CONCENTRATUM, I. A. COM. CONC., L.) *a.* Seville orange peel (dried), 3¼ lbs.; fresh lemon peel, 1½ lbs.; bruised cloves, ¾ lb.; boiling water, 9 pints; infuse for 20 minutes, press out the liquor, and, when cold, add of rectified spirit, 1 quart, and filter.

b. Dried orange peel, 18 oz.; fresh lemon peel, ½ lb.; bruised cloves, ¼ lb.; rectified spirit, 1 pint; cold water, 3 pints; macerate for 1 week, press, and filter. Very superior.

Obs. 1 fl. dr. of either of the above, added to 7 fl. dr. of water, makes a similar (preferable) preparation to the COMPOUND INFUSION OF ORANGE PEEL (Ph. L.).

Infusion of Parei'ra. *Syn.* INFUSUM PAREIRÆ (Ph. E. & D.), I. P. BRAVÆ, L. *Prep.* 1. (Ph. E.) Velvet leaf or pareira brava root, 6 dr.; boiling water, 1 pint; macerate for 2 hours in a lightly covered vessel and strain.

2. (Ph. D.) Pareira (bruised and torn), ½ oz.; boiling water, 9 fl. oz.; macerate 1 hour, and strain. In irritation and mucous discharges from the urinary organs. The corresponding preparation of the Ph. L. will be found among the DECOCTIONS.

Infusion of Parsley Root. *Syn.* INFUSUM PETROSELINI, L. From the root of garden parsley. Aromatic, diuretic, and slightly aperient. It has been highly recommended by Dr Chapman and others in dropsy, in the strangury arising from blisters, &c.; taken freely, either alone or combined with a little sweet spirit of nitre.

Infusion of Peach Leaves. *Syn.* INFUSUM PERSICÆ, I. P. FOLII, L. *Prep.* (*Pereira.*) Peach leaves (dried), ½ oz.; boiling water, 1 pint; macerate an hour and strain.—*Dose*, 1 to 2 tablespoonfuls, twice or thrice a day; to allay irritation of the bladder and urethra, and as a vermifuge.

Infusion, Pectoral. *Syn.* INFUSUM PECTORALE, L. *Prep.* (Hosp. F.) Linseed (bruised), ¾ oz.; coltsfoot leaves, ½ oz.; liquorice root (sliced) and poppy-heads, of each, ¼ oz.; boiling water, 1 pint; digest 2 hours and strain. In coughs, colds, hoarseness, &c., accompanied with a dose of aperient medicine. See SPECIES, &c.

Infusion of Pennyroy'al. *Syn.* PENNYROYAL TEA; INFUSUM PULEGII, I. MENTHÆ PULEGII, L. A popular remedy for nausea, flatulence, colds, hooping-cough, hysterical affections, obstructed menstruation, &c.

Infusion of Pep'permint. *Syn.* PEPPERMINT TEA; INFUSUM MENTHÆ PIPERITÆ, L. In flatulence, colic, griping, &c., and as a vehicle for other medicines.

Infusion of Periwin'kle. *Syn.* INFUSUM VINCÆ MINORIS, L. From the leaves of lesser periwinkle (*Vinca minor*). Astringent and tonic; in diarrhœa, dysentery, &c. Mr Weathers employs it in passive hæmorrhages, and others have recommended it as an external tonic applied to the perinæum, &c., in piles, relaxation of the genitals, &c.

Infusion of Persim'mon. *Syn.* INFUSUM PERSIMMONIS, L. From the bark of persimmon (*Diospyrus virginiana*). Astringent; very valuable in diarrhœa, hæmorrhages, agues, &c., and as a gargle in ulcerated sore throat.

Infusion of Peru'vian Bark. See INFUSION OF BARK.

Infusion of Pink'root. *Syn.* PINKROOT TEA, WORM T.; INFUSUM SPIGELIÆ, L. *Prep.* 1. From

the Indian pinkroot. Vermifuge; either combined with or followed by a purge after the 3rd or 4th dose. The dose for a child 3 to 5 years old is 1 to 2 table-spoonfuls.

2. (Compound: INFUSUM SPIGELIÆ COMPOSITUM, I. S. CUM SENNÂ, L.; *Ellis.*) Pinkroot, ½ oz.; senna, 2 dr.; fennel-seed, 3 dr.; manna, 1 oz.; boiling water, 1 pint.—*Dose,* ½ wine-glassful for a child 2 or 3 years old; in worms. See EXTRACT.

Infusion of Pleu′risy-root. *Syn.* INFUSUM ASCLEPIADIS TUBEROSÆ, L. From the root of butterfly-weed or pleurisy-root (*Asclepias tuberosa*). Expectorant and diuretic; in large doses, purgative; in colds, pleurisy, pneumonia, &c. According to Bigelow, it is a valuable mild tonic and stimulant.

Infusion of Poison-oak. *Syn.* INFUSUM RHOIS TOXICODENDRI, L. *Prep.* From the dried leaves of the poison-oak (*Rhus toxicodendron*), 3 dr.; boiling water, 1 pint. Stimulant and narcotic; chiefly in palsy and mania.

Infusion of Pop′py-heads. *Syn.* POPPY TEA; INFUSUM PAPAVERIS, L. From poppy-heads (capsules of *Papaver somniferum*). Soothing, anodyne. Sweetened with honey, it is a popular remedy for tickling cough, restlessness, &c.; also used hot, as an embrocation, in painful tumours, inflammations, &c. See INFUSION OF RED POPPY.

Infusion of Pur′ging Flax. *Syn.* INFUSUM LINI CATHARTICI, L. From the dried leaves of purging flax (*Linum catharticum*). Cathartic. The dose should be repeated at intervals of 1 or 1½ hours, until it operates.

Infusion of Quas′sia. *Syn.* QUASSIA TEA; INFUSUM QUASSIÆ (B. P., Ph. L. E. & D.), L. *Prep.* 1. (B. P.) Quassia (in chips), 55 gr.; cold distilled water, 10 oz.; infuse for ½ hour and strain. —*Dose,* 1 to 2 oz.

2. (Ph. L.) Quassia (sliced), 40 gr.; boiling distilled water, 1 pint; infuse for 2 hours in a covered vessel, and strain.

3. (Ph. E.) Quassia, 1 dr.; boiling water, 1 pint.

4. (Ph. D.) Quassia (rasped), 1 dr.; boiling water, 8½ fl. oz.

5. (Ph. U. S.) Quassia, 2 dr.; cold water, 16 fl. oz.; macerate for 12 hours and strain. As a bitter tonic, in loss of appetite, dyspepsia, &c.; either combined with alkaline carbonates or chalybeates. Sweetened with moist sugar or honey, it forms a common FLY-PAPER or FLY-POISON.

6. (Compound: INFUSUM QUASSIÆ COMPOSITUM, L.; *Ellis.*) Quassia, serpentary, and dried orange peel, of each, ¼ oz.; boiling water, 1 pint. A stimulant stomachic.

Infusion of Red Cab′bage. *Syn.* INFUSION OF BLUE CABBAGE. Used as a colour, and to make test-paper. It will not keep without the addition of about 1-10th of its weight of rectified spirit.

Infusion of Red Pop′py. *Syn.* RED POPPY TEA; INFUSUM RHŒADOS, L. From the petals of the red or corn poppy. Anodyne and pectoral. Sewetened with sugar or honey, it is a popular remedy in catarrhal affections; but the use of this, as well as of INFUSION OF POPPY-HEADS, should be accompanied by a dose of aperient medicine.

Infusion of Rhat′any. *Syn.* INFUSUM KRAMERIÆ (B. P.), INFUSUM RHATANIÆ, I. KRAMERIÆ (Ph. L. & D.), L. *Prep.* 1. (B. P.) Rhatany, bruised, 1 oz.; boiling distilled water, 20 oz.; infuse ½ hour and strain.—*Dose,* 1 to 2 oz.

2. (Ph. L.) Rhatany root, 1 oz.; boiling distilled water, 1 pint; macerate for 4 hours in a covered vessel and strain.

3. (Ph. D.) Rhatany, ½ oz.; boiling water, 9 fl. oz.; macerate 1 hour and strain. Astringent and tonic; chiefly in chronic diarrhœa.

4. (Concentrated: INFUSUM KRAMERIÆ CONCENTRATUM, L.) From 8 times the usual quantity of ingredients, as INFUSION OF CASCARILLA.

Infusion of Rhododen′dron. *Syn.* INFUSUM RHODODENDRI, L. From the leaves of yellow rhododendron (*Rhododendron chrysanthum*), ½ oz.; boiling water, ½ pint. Highly recommended by Pallas and Koelpin in gout, chronic rheumatism, and syphilis. It has marked narcotic properties.

Infusion of Rhubarb. *Syn.* INFUSUM RHEI (B. P., Ph. L. E. & D.), L. *Prep.* 1. (B. P.) Rhubarb (in thin slices), 1 oz.; boiling distilled water, 40 oz.; infuse for ½ hour and strain.—*Dose,* 1 to 2 oz.

2. (Ph. L.) Rhubarb (sliced), 3 dr.; boiling distilled water, 1 pint; macerate for 2 hours in a covered vessel and strain.

3. (Ph. D.) Rhubarb, 2 dr.; boiling water, 9 fl. oz.; macerate 1 hour.

4. (Ph. E.) Rhubarb (in coarse powder), 1 oz.; boiling water, 18 fl. oz.; infuse for 12 hours, add of spirit of cinnamon, 2 fl. oz.; and strain through linen or calico. Stomachic and purgative; along with neutral salts or aromatics.

Obs. The infusion of the Ph. E., being fully double as strong as that of the Ph. L. & D., must be taken in proportionate doses.

5. (Concentrated: INFUSUM RHEI CONCENTRATUM, L.) *a.* Rhubarb (in coarse powder), 10 oz.; rectified spirit, 1 pint; cold distilled water, 1 quart; digest 10 days, with frequent agitation, then express the liquor, and filter it; or proceed by the method of displacement.

b. Rhubarb, 3 lbs. 5 oz.; cold distilled water, 11 pints; rectified spirit, 5½ pints; as the last.

Obs. 1 fl. dr. of either of the above, added to 7 fl. dr. of water, forms 1 fl. oz. of liquid, resembling, and in many points preferable to, the infusion of the Ph. L. The above is the only way a fine, rich-coloured, and transparent concentrated preparation can be made that will keep well. Should it not prove perfectly limpid, it may be clarified in the way already mentioned.

6. (Alkaline: INFUSUM RHEI ALKALINUM, I. R. CUM POTASSÂ, L.; *Copland.*) Rhubarb, 2 dr.; carbonate of potassa, 1 dr.; boiling water, ½ pint; macerate for 4 hours, strain, and add of tincture of cinnamon, ½ fl. oz. In dyspepsia, acidity, heartburn, &c.

Infusion of Ro′ses. *Syn.* INFUSUM ROSÆ, L. *Prep.* 1. (Simple.) From the petals of red roses. Used as colouring and for a test; mixed with vinegar and sweetened with honey, it forms a popular gargle in sore throat.

2. (Compound: INFUSUM ROSÆ, Ph. E.; I. ROSÆ COMPOSITUM, Ph. L.; I. R. ACIDUM, B. P., Ph. D.) *a.* Red rose petals (broken up), 1

oz.; dilute sulphuric acid, $\frac{1}{2}$ oz.; boiling distilled water, 40 oz.; infuse for $\frac{1}{2}$ hour with the acid and water and strain.—*Dose*, 1 to 2 oz.

b. (Ph. L.) Petals of the red or damask rose (dried and pulled asunder), 3 dr.; boiling water, 1 pint; mix, and add of dilute sulphuric acid, $1\frac{1}{2}$ fl. dr.; macerate for 2 hours, strain off the liquor, and dissolve in it white sugar, 6 dr. The Edinburgh form is nearly similar.

c. (Ph. D.) Petals, 2 dr.; boiling water, $\frac{1}{2}$ pint; infuse 1 hour, strain, and add of dilute sulphuric acid, 1 fl. dr.

Obs. A vessel or glass of stoneware should be used to make the infusion in, as metallic vessels injure the colour of the liquid, and are also attacked by the acid. The best plan is to add the dilute sulphuric acid to the water before pouring it on the leaves. The infusion may be squeezed out of the leaves with the hands.

The COMPOUND INFUSION OF ROSES is principally used as a vehicle for sulphate of quinine, saline purgatives, and some other medicines. It is astringent and refrigerant, and, when diluted with water, forms a pleasant drink in febrile disorders, phthisical sweats, hæmorrhages, diarrhœa, &c. It also makes a very useful astringent gargle. *Dose*, 1 to 4 fl. oz.; either alone or diluted with water. It is incompatible with the alkalies and earths, and their carbonates and their bicarbonates.

3. (Concentrated: INFUSUM ROSÆ CONCENTRATUM, L.) *a.* Rose petals, 10 oz.; boiling distilled water, 3 pints; infuse for 2 hours, with frequent agitation, express the liquid, strain through a clean hair-sieve, and add of dilute sulphuric acid, $4\frac{1}{2}$ fl. oz.; after agitation for 5 or 6 minutes, and repose for 2 or 3 hours, decant the clear portion, and filter through paper supported on calico; next, dissolve in the liquid $1\frac{1}{4}$ lbs. of the finest white sugar, broken up into small lumps, but perfectly free from dust and dirt; lastly, pour the infusion into clean, stoppered, green-glass bottles, and, as much as possible, keep them from the light and in a cool place.

b. Rose petals, $3\frac{1}{4}$ lbs.; boiling water, 2 galls.; diluted sulphuric acid, 24 fl. oz.; finest white sugar, $6\frac{1}{2}$ lbs.; as the last.

c. The same quantity of dilute sulphuric acid and cold water, as before; mix, and infuse the rose leaves in the liquid for 48 hours, then express, filter, and add the sugar. Product very fine, and keeps well without becoming gelatinous.

Obs. This preparation is 8 times as strong as that of the Ph. L. (2, *a*). Great care should be taken that the utensils are perfectly clean, especially the press, if one is employed; and earthenware glazed with lead should be avoided. The pressing should also be conducted as rapidly as possible, to avoid the colour being injured by the iron. Clean wrought iron does not readily injure the colour of infusion of roses before the addition of the acid. When the last formula is adopted, strong pressure of the leaves with the hands can alone be safely had recourse to. If the infusion does not filter quite clear through paper, it should be set aside for a few days, when, in general, it will be found to filter more readily and satisfactorily. Should it be wanted for immediate sale, the addition of the whites of 2 or 3 eggs, diluted with 2 or 3 ounces of water, followed by violent agitation of the liquid for a few minutes, and repose for 1 or 2 hours, will usually render it 'fine,' when it may be either decanted or filtered, should it require it. It will now pass rapidly through ordinary filtering paper, and at once run clear.

Infusion of Rue. *Syn.* RUE TEA; INFUSUM RUTÆ, L. Carminative, antispasmodic, emmenagogue, and vermifuge. It is a popular and useful remedy in flatulent colic, infantile convulsions, epilepsy, hysteria, suppressed menstruation, &c.

Infusion of Rupture-wort. *Syn.* INFUSUM HERNIARIÆ. *Prep.* Rupture wood, 2 dr.; boiling water, 1 pint.

Infusion of Safflower. *Syn.* INFUSUM CARTHAMI. *Prep.* Safflower, 2 dr.; boiling water, 16 fl. oz.; infuse for an hour.—*Dose.* A wine-glassful, as a diaphoretic.

Infusion of Sage. *Syn.* SAGE TEA; INFUSUM SALVIÆ, L. *Prep.* 1. From the leaves of common garden sage. Carminative and stomachic. In flatulence and dyspepsia, and diluted with water as a drink, to lessen the nightsweats in phthisis and fever, and to stop the secretion of milk after weaning.

2. (Compound: INFUSUM SALVIÆ COMPOSITUM, L.; *Ellis.*) Sage and boneset, of each, $\frac{1}{2}$ oz.; cascarilla, 1 dr.; boiling water, $1\frac{1}{2}$ pints; infuse until cold. A wine-glassful every 3 or 4 hours in hectic fever.

Infusion of Sarsaparil'la. *Syn.* INFUSUM SARZÆ, I. SARSAPARILLÆ (Ph. U. S.), L. *Prep.* 1. From the bruised root. Dr Hancock adds $\frac{1}{2}$ fl. dr. of hydrochloric acid to each pint of the water employed, as a menstruum, by which he says the efficacy of the infusion is greatly increased. At St George's Hospital a little liquorice-root and solution of potassa is added for the same purpose.

2. (Compound: INFUSUM SARSAPARILLÆ COMPOSITUM, L. Ph. D. 1826.) Sarsaparilla-root (washed clean with a little cold water, and sliced), 1 oz.; lime-water (cold) 16 fl. oz.; macerate for 12 hours and strain. Inferior to the simple infusion, since both earths and alkalies lessen the solvent action of water on sarsaparilla. Use of both the above similar to that of the DECOCTION.

Infusion of Sas'safras. *Syn.* SASSAFRAS TEA; INFUSUM SASSAFRAS, L. From sassafras chips. Alterative, stimulant, and sudorific; a popular remedy in various cutaneous, rheumatic, scrofulous, and syphilitic affections. Hufeland recommends the addition of a little liquorice-root.

Infusion of Sav'ine. *Syn.* SAVINE TEA; INFUSUM SABINÆ, L. *Prep.* (*Pereira.*) Fresh savine leaves or herb, 1 dr.; boiling water, 8 fl. oz.; infuse in a covered vessel. Stimulant, emmenagogue, and vermifuge; in chlorosis, and suppressed menstruation depending on a torpid action of the uterine vessels; in chronic rheumatism, worms, &c.—*Dose*, 1 to 2 table-spoonfuls, cautiously administered.

Infusion of Sax'ifrage. *Syn.* SAXIFRAGE TEA; INFUSUM PIMPINELLÆ, L. From the root of burnet saxifrage (*Pimpinella saxifraga*). Astringent; in diarrhœa, and externally as a wash to remove freckles.

Infusion of Scutella''ria. *Syn.* INFUSUM SCU-

TELLARIÆ, L. *Prep.* (*Dr Spalding.*) Dried herb of *Scutellaria lateriflora*, in powder, $1\frac{1}{2}$ teaspoonfuls; boiling water, 1 pint. By teacupfuls, thrice daily, to prevent hydrophobia.

Infusion of Sen′ega. *Syn.* INFUSION OF RATTLESNAKE-ROOT, SENEKA TEA; INFUSUM SENEGÆ (B. P., Ph. E.), I. POLYGALÆ (Ph. D.), L. *Prep.* 1. (B. P.) Senega, bruised, 1 oz.; boiling distilled water, 20 oz.; infuse 1 hour and strain.—*Dose*, 1 to 2 oz.

2. (Ph. E.). Senega snake-root (bruised), 10 dr.; boiling water, 1 pint; infuse for 4 hours in a covered vessel and strain.

3. (Ph. D.) Polygala root, $\frac{1}{2}$ oz.; boiling water, 9 fl. oz. Stimulant, expectorant, and diuretic, either alone or combined with ammonia; in catarrhs, &c. See DECOCTION, EXTRACT, &c.

Infusion of Sen′na. *Syn.* SENNA TEA; INFUSUM SENNÆ (B. P., Ph. E), I. SENNÆ COMPOSITUM (Ph. L. & D.), L. *Prep.* 1. (B. P.) Senna, 1 oz.; ginger sliced, 28 gr.; boiled distilled water, 10 oz.; infuse $\frac{1}{2}$ hour and strain.—*Dose*, 1 to 2 oz.

2. (Ph. L.) Senna, 15 dr.; ginger (bruised), 4 scr.; boiling water, 1 pint; macerate for an hour in a covered vessel and strain.

3. (Ph. E.). Senna, $1\frac{1}{2}$ oz.; ginger, 4 scr.; boiling water, 1 pint (see No. 9, *below*).

4. (Ph. D.) Senna, $\frac{1}{2}$ oz.; ginger, $\frac{1}{2}$ dr.; boiling water, $\frac{1}{2}$ pint. Purgative.—*Dose*, 1 to 2 wineglassfuls. It is usually given in doses of 1 to $1\frac{1}{2}$ fl. oz., combined with 3 to 6 dr. of Epsom salts, or other saline purgative, under the name of 'BLACK DRAUGHT.'

Obs. This infusion is very apt to spoil in warm weather, to prevent which Mr Squire recommends the addition of 1 gr. of nitrate of potassa to each oz.

5. (Concentrated: INFUSUM SENNÆ CONCENTRATUM, L.) *a.* Senna, 2 lbs. 1 oz.; tepid water, 1 quart, macerate for 12 hours, frequently stirring with a stick, and express the liquor; to the 'marc,' add of tepid water, $1\frac{1}{4}$ pints, repeat the maceration for 3 hours, and again express the liquor with powerful pressure; mix the infusions, and after 2 hours' repose decant the clear portion, and evaporate it as rapidly as possible, by steam or a chloride of sodium bath, until it measures $1\frac{1}{2}$ pints; pour this into a strong bottle, and when nearly cold, add of rectified spirit. $\frac{1}{2}$ pint; bruised ginger, $3\frac{1}{2}$ oz.; macerate a week with frequent agitation, and after repose for a few days decant the clear portion, and add dilute spirit (1 to 4), q. s. to make the whole measure exactly a quart.

b. Take 8 times the quantity of senna and ginger ordered in the Ph. L., put them into a displacement apparatus, either alone or mixed with clean washed sand, and transmit water, mixed with 1-4th part of rectified spirit, through the mass, until the proper quantity of infusion is obtained.

c. (Wholesale.) Alexandrian senna (best), 7 lbs.; unbleached Jamaica ginger (finest, bruised), 3 lbs.; rectified spirit and water, of each, 1 gall.; macerate for 14 days, press out the fluid, filter, and set it aside in a well-corked bottle; then take of good East India senna, 25 lbs.; and the 'pressings' or 'marc' from the tincture, and macerate in the least possible quantity (10 or 12 galls.) of cold distilled water, for 12 or 14 hours, employing frequent agitation with a wooden spatula; next press out the liquid, and again macerate the 'marc' in cold distilled water (5 or 6 galls.) for 2 hours; press, mix the 2 liquors, strain, heat gradually to the boiling-point, carefully separate the coagulated albumen, and afterwards evaporate as quickly as possible to exactly 9 quarts; put the liquid at once into a vessel capable of holding 5 galls., bung close to exclude the air, and when nearly cold add the 'tincture' obtained from the Alexandrian senna and the ginger. The whole must now be well agitated together, and allowed to stand for a week, when the clear portion must be carefully decanted into bottles (Winchester quarts) for sale.

d. As the last, but employing hot water, and limiting the period of the infusions to 2 hours and 1 hour.

Obs. The preceding formulæ are at present employed in the wholesale trade, by nearly all those houses that are most noted for the superior quality of their 'CONCENTRATED INFUSIONS.' The products of the whole are excellent. That from *c* is very beautiful, and contains all the valuable active matter that it is possible to extract from the ingredients, under the circumstances. It also keeps well. The last one, like all preparations of senna made with hot water, is apt to drop a large deposit on standing, from which the last portion of the infusion is obtained with difficulty. They each furnish a liquid, of which 1 fl. dr. added to 7 fl. dr. of pure water forms 1 fl. oz. of a preparation precisely similar in medicinal qualities to the INFUSUM SENNÆ COMP. (Ph. L.).

From the extreme bulkiness of senna, it has become a practice with certain unprincipled druggists to employ only 1-3rd or 1-4th of the proper quantity of that drug, and to add burnt sugar or treacle to bring up the consistence and and colour, and alkaline solution of gamboge to impart the necessary purgative quality. CONCENTRATED INFUSION OF SENNA, as generally met with, is nearly worthless. This arises from either the employment of inferior senna, or the destruction of its active principle by the lengthened exposure to heat and atmospheric oxygen during its manufacture.

6. (With COFFEE; INFUSUM SENNÆ CUM CAFFEÂ, L.) *a.* (*Foy.*) Senna, 2 dr.; roasted coffee (ground), 1 dr.; boiling water and hot milk, of each, 3 fl. oz.; infuse for 12 hours (4 ?), and strain. For an adult; to be taken in the morning fasting.

b. (*Guersand* and *Blake.*) Senna, 10 to 30 gr. (according to age); hot coffee and hot milk at will; infuse, and when cold strain, and sweeten it with sugar, q. s. As a purge for children.

7. (With LEMON JUICE: INFUSUM SENNÆ LIMONIATUM, L.) From senna, $1\frac{1}{2}$ oz.; fresh lemon peel, 1 oz.; lemon juice, 1 fl. oz.; boiling water, 16 fl. oz.; infuse.

8. (With RHUBARB: INFUSUM SENNÆ ET RHEI, L.; *Ellis.*) Senna, 6 dr.; manna, 1 oz.; rhubarb and cardamoms, of each, (bruised), 2 dr.; boiling water, 1 pint; infuse 1 hour and strain.

9. (With TAMARINDS: INFUSUM SENNÆ COMPOSITUM, Ph. E.; SENNÆ CUM TAMARINDIS, L., Ph. E.) Senna, 3 dr.; tamarinds, 1 oz.; coriander seeds, 1 dr.; sugar, ½ oz. (if brown, 1 oz.); boiling water, 8 fl. oz.; infuse for 4 hours, with agitation, and then strain through calico. Pleasanter than the ordinary infusion of senna.

10. (With TARTAR: INFUSUM SENNÆ TARTARIZATUM, L.) From senna, 1½ oz.; coriander seeds, 4 dr.; cream of tartar, 2 dr.; boiling water, 16 fl. oz.

Infusion of Ser'pentary. *Syn.* INFUSUM SERPENTARIÆ (B. P., Ph. L. & E.), L. *Prep.* 1. (B. P.) Serpentary, bruised, 1 oz.; boiling distilled water, 40 oz.; infuse ½ hour and strain.—*Dose,* 1 to 2 oz.

2. (Ph. L.) Serpentary or Virginian snakeroot, ½ oz.; boiling distilled water, 1 pint; macerate for 4 hours in a closed vessel, and strain. The form of the Ph. E. is similar. As a stimulating expectorant and diaphoretic; in chronic catarrhs, low fevers, agues, &c.

Infusion of Sessamum. (*Dr Wood.*) *Syn.* INFUSUM SESAMI. *Prep.* Two fresh leaves of sessamum (*Venne*) infused in 8 oz. of cold water, form a mucilaginous demulcent drink. Dried leaves require hot water.

Infusion of Silk-weed. *Syn.* INFUSUM ASCLEPIADIS. *Prep.* Bark of the common silkweed, 1 oz.; boiling water, 1 pint.—*Dose,* 1 oz. to 1½ oz. In cough and dyspnœa.

Infusion of Simaru'ba. *Syn.* INFUSUM SIMARUBÆ (B. P., Ph. E. & D.), L. *Prep.* 1. (B. P.) Simaruba, bruised, 3 dr.; boiling water, 1 pint; infuse 2 hours and strain.—*Dose,* 1 to 2 oz.

2. (Ph. E. & Ph. L., 1836.) Bark of the bitter simaruba or mountain damson, 3 dr.; boiling water, 1 pint; macerate 2 hours and strain.

3. (Ph. D.) Simaruba bark, 2 dr.; boiling water, 9 fl. oz. Tonic, and, in large doses, emetic; in chronic diarrhœa and dysentery, either alone or combined with opium; and in agues, dyspepsia, &c.

4. (Compound: INFUSUM SIMARUBÆ COMPOSITUM, L.; *Foy.*) Simaruba bark and wormwood, of each, 2 dr.; boiling water, 1 pint; infuse for 15 minutes, strain, and add of syrup of gentian, 1 fl. oz. In agues and dyspepsia.

Infusion of Slip'pery Elm. *Syn.* INFUSUM ULMI (Ph. U. S.), I. U. FULVÆ, L. *Prep.* (Ph. U. S.) Inner bark of slippery elm (*Ulmus fulva*), 1 oz.; boiling water, 16 fl. oz.; infuse for 2 hours, and strain. Demulcent.

Infusion of Soap-wort. *Syn.* INFUSUM SAPONARIÆ, L. From soap-wort root (*Saponaria officinalis*). Aperient and demulcent; also reputed alterative and antisyphilitic.

Infusion of South'ernwood. *Syn.* SOUTHERNWOOD TEA; INFUSUM ABROTANI, L. From the herb southernwood, or old man (*Absinthium abrotanum*). Antispasmodic, tonic, and vermifuge; in hysteria, difficult and painful menstruation, worms, &c.

Infusion, Stimulant. *Syn.* INFUSUM STIMULANS, L. *Prep.* (*Dr Paris.*) Black mustard-seed (bruised), and dittander, of each, ½ oz.; boiling water, 16 fl. oz.; macerate for 1 hour, strain, and when cold, add of spirit of sal-volatile, 1 fl. dr.; spirit of pimento, ½ fl. oz.—*Dose,* 2 tablespoonfuls 3 times a day; in palsy.

Infusion of Stink'ing Hel'lebore. *Syn.* INFUSUM HELLEBORI FŒTIDI, L. *Prep.* (*Woodville.*) Dried leaves of setter-wort or *Helleborus fœtidum,* ½ dr. (or green herb, 2 dr.); boiling water, 16 fl. oz.; macerate 1 hour and strain. Aperient and vermifuge; and emetic, in large doses. It is chiefly used against the large round worms of children and females, taken fasting.

Infusion of Suc'cory. *Syn.* CHICORY TEA; INFUSUM CHICORII, L. From the dried root. Aperient, deobstruent, and tonic; either alone or sweetened with honey or sugar.

Infusion of Sweet Flag. *Syn.* CALAMUS TEA, SWEET-FLAG T.; INFUSUM ACORI, I. CALAMI AROMATICI, L. An aromatic, stimulant, tonic, and stomachic. See SWEET FLAG.

Infusion of Tam'arinds. *Syn.* INFUSUM TAMARINDI, L. Cooling and laxative; in sore throat, febrile affections, &c., taken *ad libitum.* See INFUSION OF SENNA.

Infusion of Tan'sy. *Syn.* TANSY TEA; INFUSUM TANACETI, L. From the dried herb, or the green herb using double the quantity. Aromatic, bitter, tonic and vermifuge.

Infusion of Tar. *Syn.* TAR WATER, TAR TEA; INFUSUM PICIS LIQUIDÆ, AQUA P. L. (Ph. D.), L. *Prep.* 1. (*Bishop Berkeley.*) Wood tar, 1 quart; cold water, 1 gall.; stir with a stick for 15 minutes, then allow the tar to subside, strain, and keep it in well-stoppered jars.

2. (Ph. D.) As the last. Taken to the extent of a pint daily in chronic catarrhal and nephritic affections; also used as a lotion in chronic cutaneous diseases, especially those of the scalp in children. See DECOCTION.

Infusion of Tarax'acum. See INFUSION OF DANDELION.

Infusion of Tobac'co. *Syn.* TOBACCO WATER; INFUSUM TABACI, L. *Prep.* (Ph. D. 1826). Tobacco leaves, 1 dr.; boiling water, 16 fl. oz.; macerate for an hour. Used for enemas; in strangulated hernia, obstinate colic, &c., observing not to administer more than one half at a time; also as a wash to kill pediculi.

Infusion, Tonic. See INFUSIONS OF CALUMBA, CASCARILLA, GENTIAN, &c., also MIXTURES.

Infusion of Tre'foil. See INFUSION OF BUCKBEAN.

Infusion of Tu'lip-tree Bark. *Syn.* INFUSUM LIRIODENDRI, L. From the bark of the tulip tree (*Liriodendron tulipifera*). Diaphoretic, stimulant, stomachic, and tonic; in dyspepsia, fevers, &c.; also used to flavour liquors.

Infusion of Tur'meric. *Syn.* INFUSUM CURCUMÆ, L. Used as a test and to prepare test-paper. When required for keeping, about 1-7th of its volume of rectified spirit must be added.

Infusion of Valer'ian. *Syn.* INFUSUM VALERIANÆ (B. P., Ph. L. & D.), L. *Prep.* 1. (B. P.) Valerian, bruised, 120 gr.; boiling distilled water, 10 oz.; infuse 1 hour and strain.—*Dose,* 1 to 2 oz.

2. (Ph. L.) Valerian root, ½ oz.; boiling distilled water, 1 pint; infuse for an hour in a covered vessel and strain.

3. (Ph. D.) Valerian, 2 dr.; boiling water, 9

fl. oz. Antispasmodic and nervine; in hysteria, hypochondriasis, epilepsy, and low fevers.

4. (Compound: INFUSUM VALERIANÆ COMPOSITUM, L.) Yellow cinchona bark, 1 oz.; valerian, ½ oz.; boiling water, 1 pint; as before. In debilitated nervous habits.

Infusion of Vanil'la. *Syn.* VANILLA TEA; INFUSUM VANILLÆ, L. *Prep.* Vanilla, 1½ dr.; boiling water, 1 pint. A stimulant antispasmodic; in hysteria, rheumatism, anaphrodisia, &c.; but chiefly used as a flavouring for liqueurs, confectionery, &c.

Infusion of Vittie Vayr. *Syn.* VITTIE VAYR TEA; INFUSUM VETIVERIÆ, L. From the roots of *Andropogon muricatus* (VETIVER, VITTIE VAYR, or CUSCUS). Antispasmodic, diaphoretic, and stimulant, and, when warm, diaphoretic and emmenagogue; in rheumatism, gout, slight febrile cases, &c.; and as a phophylactic of cholera. See ESSENCE.

Infusion of Wall-pel'litory. *Syn.* INFUSUM PARIETARIÆ, L. From the dried herb (*Parietaria officinalis.*) Aperient, diuretic, and pectoral; in asthmas, dropsies, calculous affections, &c.

Infusion of Wal'nut-leaves. *Syn.* WALNUT-LEAF TEA; INFUSUM JUGLANDIS, L. From the fresh leaves of the common walnut (*Juglans regia*); also from the inner wood-bark and the green rind of the fruit. See DECOCTION and EXTRACT.

Infusion of Water-fen'nel. *Syn.* INFUSUM PHELLANDRI, L. *Prep.* (*Bird.*) Seeds of water-fennel, 5 dr.; boiling water, 1 pint.—*Dose*, 3 to 4 fl. dr.; to check excessive expectoration.

Infusion of Whor'tleberry. *Syn.* INFUSUM UVÆ-URSI, L. With alkalies, henbane, or opium in cases of the urinary organs; and with sulphuric acid and foxglove in affections of the lungs. See DECOCTION and EXTRACT.

Note.—Infusum Uvæ-ursi of the Brit. Pharmacopœia.

Infusion of Wild-cherry Bark. *Syn.* INFUSUM PRUNI VIRGINIANÆ (Ph. U. S.), L. *Prep.* (Ph. U. S.) Wild cherry-tree bark (*Prunus virginiana* for *Ceratus serotina*), ½ oz.; cold water, 16 fl. oz.; in use 24 hours and strain. A valuable tonic and febrifuge. Wild-cherry bark also exercises a sedative action on the circulatory and nervous system, and is much used in America in a variety of diseases.

Infusion of Wild Gin'ger. *Syn.* INFUSUM ASARI CANADENSIS, L. From the root of wild ginger or Canada snake-root *Assarum canadense.* A warm stimulant diaphoretic, in the same cases as INFUSION OF VIRGINIAN SNAKE-ROOT.

Infusion of Will'ow Bark. *Syn.* INFUSUM SALICIS, L. From the bark of the white or common willow (*Salix alba.*) Astringent, tonic, and febrifuge; often used instead of INFUSION OF CINCHONA.

Infusion of Win'ter-green. *Syn.* INFUSUM PYROLÆ, I. CHIMAPHILÆ, L. Astringent, tonic, and diuretic; in dropsy, nephritic pains, and chronic affections of the urinary organs. It blackens the urine, like uvæ-ursi. See DECOCTION.

Infusion of Worm'wood. *Syn.* WORMWOOD TEA, INFUSUM ABSINTHII, L. From the fresh tops of the plant, or from only half the quantity of the dried herb. In loss of appetite, dyspepsia, amenorrhœa, leucorrhœa, gout, worms, &c. See BITTERS.

INHALA'TION. *Syn.* INHALATIO VAPORES, L. In *medicine*, the drawing in or inspiring of vapour with the breath. Inhalations (INHALATIONES) are vapours or gases imbibed for the purpose of medicating the mucous membrane of the air-passages. The substances that are to furnish the vapours or fumes are put into a vessel called an 'inhaler' (see INHALER), which may be simply a small covered pot or mug of metal or glass furnished with a short flexible tube, terminating in a small mouth-piece. In many cases even this simple apparatus may be dispensed with, and the fumes inhaled by holding the head over a vessel containing a little of the substance furnishing them; or, as with chloroform, a little may be dropped on a handkerchief or napkin, which is then held to the nose.

Inhalations prescribed at the Throat Hospital are of 5 kinds, as follows:

1. Hot. Steam impregnated with volatile matter; temperature, 130°—150° F.
2. Cold. Temperature, 60°—100° F.
3. Dry. Volatile matters vaporised by heat.
4. Atomised. Inhalations of atomised fluids.
5. Fuming. Inhalations of the smoke of ignited nitrated paper.

For full particulars the Throat Hospital Pharmacopœia should be consulted. The following are some of the most important forms:

Vapor Acidi Acetici. Glacial acetic acid and acetic acid, equal parts: mix (Throat). 2 teaspoonfuls in a pint of water at 140° F. for each inhalation. Antiseptic; used for inflammatory sore throat of scarlet fever.

Vapor Acidi Carbolici. Liquefied carbolic acid, 30 minims; boiling water, 20 oz. (Royal Chest). Carbolic acid, 20 gr.; hot water, 1 pint (City Chest). Carbolic acid crystals, 7 dr.; water, 1 dr.: dissolve (Throat). For hot moist air inhalation: 20 drops in a pint of water at 140° F. for each inhalation. For hot dry inhalation: A teaspoonful to be poured into the apparatus for dry inhalation, and the vapour inhaled. For cold inhalation: 2 teaspoonfuls in a pint of water at 80°—100° F. Antiseptic; useful in syphilitic ulcerations.

Vapor Acidi Carbolici (Spray). Carbolic acid, 30 gr.; distilled water, 10 oz. (Throat).

Vapor Acidi Hydrocyanici. Diluted hydrocyanic acid, 1 dr.; water to 1 oz.: mix (Throat). A teaspoonful in a pint of water at 80° F. for each inhalation. Sedative; useful in cough of laryngeal phthisis.

Vapor Acidi Lactici. Lactic acid, 20 minims; water, 1 oz.: for atomised inhalation (Throat).

Vapor Acidi Sulphurosi (Cold). Sulphurous acid, 1 dr.; water (from 60°—100° F.) 20 oz. for each inhalation (Throat). Stimulant.

Vapor Acidi Sulphurosi (Spray). Sulphurous acid, 5 minims; water, 1 oz.: for atomised inhalation (Throat).

Vapor Acidi Tannici. Tannic acid, 5 to 20 gr.; water, oz.: for atomised inhalation (Throat).

Vapor Ætheris. Ether, rectified spirit, equal parts: mix (Throat). A teaspoonful in a pint

of water at 80° F. for each inhalation. Sedative and antispasmodic.

Vapor Amyl Nitritis. Nitrite of amyl, 24 minims; water to 3 oz.: mix. A teaspoonful in 20 oz. of water at 100° F. for each inhalation. Antispasmodic; valuable in asthma and spasm of the glottis.

Vapor Anisi. Oil of aniseed, 6 minims; light carbonate of magnesia, 3 gr.; water 1 oz.: mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for each inhalation. Mildly stimulant.

Vapor Benzoini. Add 1 dr. comp. tincture of benzoin to 10 oz. of hot water, and let the vapour be inhaled (London). Comp. tincture of benzoin, 1 dr., to 20 oz. of water at 140° F. A most valuable sedative inhalation for acute inflammation of the pharynx and larynx (Throat). Compound tincture of benzoin, 1 dr.; hot water, 1 pint (City Chest).

Vapor Cajuputi. Oil of cajuput, 8 minims; light carbonate of magnesia, 4 gr.; water to 1 oz.: mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for each inhalation. Stimulant; useful when the pharyngeal secretion is excessive.

Vapor Calami Aromatici. Oil of sweet flag, 5 minims; light carbonate of magnesia, 2½ gr.; water to 1 oz.: mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for each inhalation. A powerful stimulant in cases of chronic congestion of the larynx.

Vapor Calcis. Lime-water for atomised inhalation in diphtheria (Throat).

Vapor Camphoræ. Spirit of camphor, 10 minims; rectified spirit, 20 minims; water to 1 dr.; to be added to 1 pint of boiling water (Chest). Spirit of camphor, 2 dr.; hot water, 1 pint (City Chest). Spirit of camphor, 1 dr.; rectified spirit, 3 dr.; water to 1 oz.: mix (Throat). A teaspoonful in a pint of water at 140° F. for each inhalation. To be inhaled slowly. Stimulant.

Vapor Conii. Dried carbonate of soda, 20 gr.; water, 20 oz., at 140° F.: dissolve, and add juice of conium, 2 dr.: for an inhalation (Throat). Sedative.

Vapor Conii c. Ammoniâ. Juice of conium, 2 dr.; solution of ammonia, 10 minims; boiling water, 20 oz. (Royal Chest).

Vapor Creosoti. Creosote, 10 minims; light carbonate of magnesia, 2 gr.; water to 1 dr.; to be added to a pint of boiling water (Royal Chest). Creosote, ½ dr.; mucilage, ½ dr.; hot water, 10 oz (London). Creosote, ½ oz.; light carbonate of magnesia, 90 gr.; water to 3 oz.: mix (Throat). A teaspoonful in a pint of water at 140° F. for each inhalation. Stimulant; serviceable for chronic congestion of the larynx.

Vapor Cubebæ. Oil of cubebs, 2 dr.; light carbonate of magnesia, 60 gr.; water to 3 oz. (Throat). A teaspoonful in a pint of water at 140° F. for each inhalation. Valuable stimulant, especially in laryngorrhœa.

Vapor Cubebæ c. Limone. Oil of cubebs, 1½ dr.; oil of lemons, ½ dr.; light carbonate of magnesia, 1 dr.; water to 3 oz.: mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for each inhalation.

Vapor Pini Pumilionis. Oil of mountain pine, 1½ dr.; light carbonate of magnesia, 45 gr.; water to 3 oz.: mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for each inhalation. Stimulant; more powerful than firwood oil.

Vapor Pini Sylvestris. Oil of Scotch pine (firwood oil), 2 dr.; light carbonate of magnesia, 1 dr.; water to 3 oz.; mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for one inhalation. Mild stimulant; useful in chronic laryngitis.

Vapor Potassæ Nitratis (*Nitrated Papers*).
1. Nitrate of potash, 30 gr.; water, 1 oz.: dissolve.
2. Nitrate of potash, 45 gr.; water, 1 oz.: dissolve.
3. Nitrate of potash, 60 gr.; water, 1 oz.: dissolve (Throat).

Saturate white blotting-paper in either of these solutions, and dry it. Cut the paper into pieces 3 inches long, ½ inch broad, which enables the medical attendant to order a definite quantity. Light a paper, drop it into the fuming inhaler, or any cylindrical vessel, and inhale the smoke. From 1 to 6 papers may be used in succession for each inhalation. Antispasmodic.

Vapor Salviæ. Oil of sage, 30 minims; light carbonate of magnesia, 15 gr.; water to 3 oz.; mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for each inhalation. Stimulant.

Vapor Santali. Oil of sandal-wood, 20 minims; rectified spirit, 3 oz.; mix (Throat). 10 or 15 drops to be used with the dry inhaler, and the vapour inhaled; a fresh quantity may be added during the inhalation to make the amount of 1 teaspoonful. It may also be used with magnesia for steam inhalation. Sedative; valuable in subacute inflammation with increased mucous secretion.

Vapor Sodii Chloridi. Chloride of sodium, 5 gr.; water, 1 oz.; for atomised inhalation (Throat).

Vapor Terebinthinæ. Spirit of turpentine, 1 dr.; tincture of larch, 3 dr.; hot water, to 10 oz. (Consumption).

Vapor Thymolis. Thymol, 20 gr.; rectified spirit, 3 dr.; light carbonate of magnesia, 10 gr.; water to 3 oz.; mix (Throat). A teaspoonful in 20 oz. of water at 140° F. for each inhalation. A strong stimulant and disinfectant; used in pharyngitis and laryngitis when associated with exanthemata.

INHALER (**Chloride of Ammonium**). (*Godfrey's* Inhaler.) The vapour of chloride of ammonium has long been more or less used in the treatment of chronic catarrh of the respiratory organs; but it is only within the last few years that this remedy has acquired a marked reputation in the treatment of catarrh of the mucous membrane of the ear, nose, and throat. It is also being very extensively used in bronchitis, asthma, and hay-fever.

Hitherto there has been great difficulty in determining a suitable apparatus that shall yield a plentiful cloud of smoke (chloride of ammonium in a minute state of division), and in a neutral condition, which is essential to its satisfactory employment. There are many advantages in being able to bring the remedial agents into direct contact with the diseased surfaces of organs,

and it is now possible with this inhaler to convey, by means of the inspiratory current, a copious and perfectly neutral cloud of chloride of ammonium to any diseased part of the respiratory tract. It has proved of great value in that loss of voice to which clergymen are subject, and in those cases of temporary hoarseness to which members of the military and naval professions are liable. The inhalation of chloride of ammonium has proved very useful when the local application of astringent solutions has been used without effect. This inhaler is simple and portable, and contains no water. Pumilio pine oil, which renders the vapour agreeably stimulating, or any other volatile substance, may be used on the sponge through which the vapour passes.

The accompanying illustration represents the inhaler. It is usually directed by the medical

profession to be used twice a day, and the inhalation on each occasion to be continued for five minutes.

INJEC'TION. *Syn.* INJECTIO, L. In *medicine*, any liquid medicine thrown into a cavity of the body by means of a syringe or an elastic bag. Those thrown into the rectum are commonly called 'clysters' or 'enemata,' and are noticed under the head of ENEMA. The following are the principal injections employed in medical practice at the present day:

Injection of Ac'etate of Cop'per. *Syn.* INJECTIO CUPRI ACETATIS, L. *Prep.* From verdigris, 10 gr.; oil of almonds (hot), 4½ oz.; triturate until dissolved and strain. Detergent.

Injection of Ac'etate of Lead. *Syn.* INJECTIO PLUMBI ACETATIS, L. *Prep.* 1. Sugar of lead, ½ dr.; distilled water, ½ pint.

2. (*Dr Collier.*) Acetate of lead, 40 gr.; rose-water, 8 fl. oz. Astringent and sedative. See SEDATIVE INJECTION.

Injection of Ac'etate of Zinc. *Syn.* INJECTIO ZINCI ACETATIS, L. *Prep.* 1. (*Ellis.*) Acetate of zinc, 8 gr.; rose-water, 4 fl. oz.

2. (*Brodie.*) Sulphate of zinc, 1 dr.; sugar of lead, 80 gr.; water, 1 pint; dissolve separately, mix, and filter. Astringent.

Injection Alkaline. *Syn.* INJECTIO ALKALINA, I. LITHONTRIPTICA, L. *Prep.* (*Chevallier.*) Carbonate of soda, 1 dr.; Castile soap, 2 dr.; water, 12 fl. oz.; dissolve. In certain forms of calculus.

Injection of Aloes. (*Bories.*) *Syn.* INJECTIO ALOES. *Prep.* 1. Aloes, 10 gr.; muriate of ammonia, 10 gr.; honey of roses, 1 oz.; fennel-water, 6 oz.

2. (*Dr Reece.*) Alum, 1 dr.; acetate of lead, 1½ dr.; triturate with 6 oz. of boiling water, and in an hour filter.

Injection of Al'um. *Syn.* INJECTIO ALUMINIS, L. *Prep.* 1. (*Dr Collier.*) Alum, 18 gr.; rose-water, 6 fl. oz.; dissolve. For the urethra.

2. (*Collier.*) Alum, 3 dr.; water, 1 quart. For the vagina.

3. (Ph. Ch.) Alum, 4 gr.; rose-water, 4 fl. oz. The above are all astringent.

Injection of Ammo''nia. *Syn.* INJECTIO AMMONIÆ, L. *Prep.* 1. (*Dr Ashwell.*) Liquor of ammonia, 1 to 2 fl. dr.; milk, 1 pint. In obstructed menstruation.

2. (*Lavagna.*) Liquor of ammonia, 8 to 20 drops; milk, 2 fl. oz. As the last, thrice daily, beginning with the least quantity of ammonia.

3. Liquor of ammonia, 1 fl. dr.; mucilage, 1 oz.; water, 9 fl. oz. As the last.

Injection of Ammo''nio-Sulphate of Cop'per. *Syn.* INJECTIO CUPRI AMMONIATI, L. *Prep.* (*Swediaur.*) Ammonio-sulphate of copper, 5 gr.; rose-water, 8 fl. oz. In chronic gonorrhœa.

Injection of Bichlo''ride of Mer'cury. *Syn.* INJECTIO HYDRARGYRI BICHLORIDI, L. *Prep.* 1. Corrosive sublimate, 2 gr.; rose-water, 5 fl. oz.; hydrochloric acid, 1 drop.

2. Corrosive sublimate and sal-ammoniac, of each, 5 to 10 gr.; water, 1 pint.

3. Sublimate, 5 gr.; rose-water, 2½ fl. oz. Used to promote healthy action, and to prevent infection.

Injection of Cal'omel. *Syn.* INJECTIO CALOMELANOS, I. HYDRARGYRI CHLORIDI, L. *Prep.* (St B. Hosp.) Calomel, 1 dr.; mucilage, 1 fl. oz.; water, ½ pint. Some persons order 'quince mucilage.'

Injection of Carbolic Acid. (Throat Hosp.) *Syn.* INJECTIO ACIDI CARBOLICI. *Prep.* Carbolic acid, 5 gr.; water, 1 oz.; mix. Antiseptic.

Injection of Car'bonate of Lead. *Syn.* INJECTIO CERUSSÆ, I. PLUMBI CARBONATIS, L. *Prep.* (Hosp. F.) Carbonate of lead (finely levigated), ½ dr.; sulphate of zinc, 8 gr.; mucilage, 1 oz.; rose-water, 5 oz. Cooling and astringent.

Injection of Chlo''ride of Lime. *Syn.* INJECTIO CALCIS HYPOCHLORIS, L. *Prep.* Chloride of lime, ½ dr.; water, ½ pint; agitate well together, and filter. To prevent infection.

Injection of Chlo''ride of So'da. *Syn.* INJECTIO SODÆ HYPOCHLORIS, L. *Prep.* From solution of chloride of soda, 1 fl. dr.; rose-water, 3 fl. oz. As the last.

Injection of Chlo''ride of Zinc. *Syn.* INJECTIO ZINCI CHLORIDI, L. *Prep.* From chloride of zinc, 2 gr.; rose-water, 3 fl. oz.; hydrochloric acid, 1 drop. In gonorrhœa.

Injection of Er'got. *Syn.* INJECTIO ERGOTÆ, I. SECALIS CORNUTI, L. *Prep.* 1. (*Boudin.*) Ergot, 1 dr.; boiling water, 8 fl. oz.; infuse until cold. When the urethra is highly sensitive.

2. (*Descrolles.*) Powdered ergot, 1 oz.; boiling water, 1 pint. Both the above are used in chronic inflammation of the vagina, and in gonorrhœa.

Injection of Gal'lic Acid. *Syn.* INJECTIO ACIDI GALLICI, L. *Prep.* (*Dunglison.*) Gallic acid, ½ dr.; water, 1 pint. In leucorrhœa.

Injection of Galls. *Syn.* INJECTIO GALLÆ, L. *Prep.* From galls (bruised), 2 dr.; boiling water, 1 pint; infuse 1 hour and strain. Astringent; in leucorrhœa.

Injection of Hydrochlo''ric Acid. *Syn.* INJECTIO ACIDI HYDROCHLORICI, L. *Prep.* From hydrochloric acid, 10 drops; soft water, 5 fl. oz.

To prevent and to remove recent infection; also to remove particles of lime and iron from the eye.

Injection of Hydrocyan'ic Ac'id. *Syn.* INJECTIO ACIDI HYDROCYANICI, L. *Prep.* Medicinal hydrocyanic acid, 1 fl. dr.; soft water or almond emulsion, 1 pint. Anodyne; to allay excessive irritability, both in chronic ophthalmia and gonorrhœa, and to relieve chordee; but in all cases it must be used with caution, and at first largely diluted with water.

Injections, Hypodermic. *Syn.* INJECTIONES HYPODERMICÆ; INJECTIONES SUBCUTANEÆ.

1. **Injectio Apomorphinæ Hypodermica.** *Syn.* HYPODERMIC INJECTION OF APOMORPHINE. Hydrochlorate of apomorphine, 2 gr.; camphor water, 100 minims. This solution soon changes blue; the addition of a trace of hydrochloric acid will assist to keep it.

2. **Injectio Ergotini Hypodermica.** *Syn.* HYPODERMIC INJECTION OF ERGOTIN. (B. P.) Ergotin, 1 part; camphor water, 2 parts.

3. **Hypodermic Injection of Perchloride of Mercury.** (*Dr Staub.*) Perchloride of mercury and chloride of ammonium, of each, 20 gr.; chloride of sodium about 62 gr.; distilled water, 20 gr. After filtration the whole is mixed with solution of the white of 1 egg and 4½ dr. of water. The solution contains $\frac{1}{33}$ gr. of perchloride to every 20 drops. $\frac{1}{6}$ gr. of perchloride to be injected each day.

4. **Hypodermic Injection of Morphia.** (B. P.). Hydrochlorate of morphia, 92 gr.; solution of ammonia, acetic acid, distilled water, of each, q. s. Dissolve the hydrochlorate in 2 oz. of distilled water by a gentle heat, then add the solution of ammonia, so as to precipitate the morphia, and render the liquid slightly alkaline; allow it to cool; collect the precipitate on a filter, wash with distilled water, and allow it to drain; then transfer the morphia to a porcelain dish, and add acetic acid until the morphia is dissolved, and a very slightly acid solution is formed. Now add distilled water, q. s. to make the solution measure 2 fl. oz. For subcutaneous injection, 1 to 6 minims.

5. Sulphate of morphia is a very good soluble salt.

6. **Hypodermic Injection of Quinine.** Three to 6 gr. of *neutral* sulphate of quinine placed on a watch-glass, previously warmed, without acid; to this add 12 minims of distilled water, and apply a moderate heat by a spirit-lamp for a second or two. The syringe should be warmed before being used.

Dr Rosenthal advocates the use of glycerin as a medium for the solution of various substances used for subcutaneous injection. The glycerin must be very pure. By gradual elevation of temperature it can be made to take up a large number of certain alkaloids and salts, and will retain them dissolved for a year. 1 fl. dr. will dissolve 1 scr. of sulphate of quinine, and 10 gr. of hydrochlorate of morphia. Dr Rosenthal states that the injection of quinine has been found very useful in intermittents.

Injection of Io'dide of I'ron. *Syn.* INJECTIO FERRI IODIDI, L. *Prep.* 1. (*Ricord.*) Iodide of iron, 6 gr.; water, 5 fl. oz. In gonorrhœa, gradually increasing the quantity of iodide.

2. (*Soubeiran.*) Iodide of iron, 3 to 4 dr.; water, 1 pint. In suppressed and painful menstruation, leucorrhœa, &c. Both are astringent and well adapted to scrofulous patients.

Injection of I'odide of Potas'sium. *Syn.* INJECTIO POTASSII IODIDI, L. *Prep.* (*Foy.*) Iodide of potassium, 3 gr.; pure water, 1 pint. As a stimulant to fistulous sinuses and ulcers in persons of scrofulous habits.

Injection of I'odine. *Syn.* IODURETTED INJECTION; INJECTIO IODURETA, I. IODINII, L. *Prep.* 1. (*M. Ameuille.*) Tincture of iodine, 1 part; water, 5 or 6 parts. In refractory fistulæ.

2. (*M. Bonnet.*) Iodine, 1 part; iodide of potassium, 2 parts; water, 10 parts. In scrofulous hydrarthrosis, &c.

3. (*Bransby Cooper.*) Compound tincture of iodine, 2 fl. dr.; water, 6 fl. dr. In hydrocele.

4. (*Guibourt.*) Iodine, 4 gr.; iodide of potassium, 8 gr.; water, 1 pint. To stimulate fistulous sinuses.

5. (*Velpeau.*) Tincture of iodine, 1 fl. dr.; water, 3 fl. dr. In hydrocele.

Injection of Nitrate of Sil'ver. *Syn.* INJECTIO ARGENTI NITRATIS, L. *Prep.* 1. (*Acton.*) Nitrate of silver, 3 gr.; distilled water, ½ pint; dissolve.

2. (*Dr Arnott.*) Nitrate, 12 gr.; water, 1 fl. oz.

3. (*Dr Collier.*) Nitrate, 2 gr.; rose-water, 1 fl. oz.

4. (*Dr Culverwell.*) Nitrate, 20 to 30 gr.; water, 1 fl. oz.

5. (*Dr Jewell.*) Nitrate, 12 gr.; water, 6 fl. oz.

6. (*Ricord.*) Nitrate, 8 gr.; water, 1 fl. oz.

7. (West. Hosp.) Nitrate, 1½ gr.; diluted nitric acid, 1¼ minims; distilled water, 1 fl. oz.

Obs. The weaker solutions are used in chronic gonorrhœa, gleet, and leucorrhœa; those of an intermediate strength to prevent an attack of gonorrhœa following the incipient symptoms of that disease; and the strongest chiefly in spermatorrhœa. Their use requires great caution.

Injection, Oleaginous. *Syn.* INJECTIO OLEOSA. *Prep.* Oil of almonds, 4 oz.; liquid subacetate of lead, 8 drops.

Injection of O''pium. *Syn.* INJECTIO OPII, I. OPIATA, L. *Prep.* 1. Tincture of opium or wine of opium, 1 to 2 fl. dr. (according to circumstances); water, 5 fl. oz. As an anodyne, in gonorrhœa.

2. (*Foy.*) Extract of opium, 6 gr.; extract of belladonna, 1½ dr.; decoction of wild lettuce, 16 fl. oz. In neuralgia and hæmorrhages.

Injection of Opium with Lead. (*Wendt.*) *Syn.* INJECTIO PLUMBI OPIATA. *Prep.* Extract of opium, 1½ gr.; distilled water, 2 oz.; mucilage, 2 dr.; liquid subacetate of lead, 4 drops.

Injection of Pancreas. (*Merkel.*) *Syn.* INJECTIO PANCREATINI. *Prep.* One bullock's pancreas; glycerin, 8 oz. Rub the finely minced pancreas with the glycerin, mix 1-3rd of this mixture with from 4 to 5 oz. of finely minced meat, and inject into the rectum. Said to be easily digested.

Injection of Platino-Chloride of Soda. (*Hoeffer.*)

Syn. INJECTIO PLATINO-CHLORIDI SODII. *Prep.* Decoction of poppy, 8 oz.; chloride of platinum and sodium, ½ dr.

Injection, Sed'ative. *Syn.* INJECTIO SEDATIVA, L. *Prep.* (Hosp. F.) Oil of almonds, 1 oz.; solution of diacetate of lead, 20 drops. Cooling, sedative, and emollient.

2. (*Wendt.*) Aqueous extract of opium, 1½ gr.; mucilage, 2 dr.; solution of diacetate of lead, 4 drops; water, 2 fl. oz. Cooling, sedative, and anodyne.

3. (*Gassincourt.*) Simple emulsion, 5 fl. oz.; decoction of poppies, 16 fl. oz.; white of 1 egg; mix. In acute gonorrhœa.

Injection, Stim'ulating. *Syn.* INJECTIO STIMULANS, L. *Prep.* (St Marie.) Myrrh, 1 oz.; quicklime, 2 oz.; water, 1 quart; digest for 2 or 3 days, and decant the clear portion. In fistulous ulcers.

Injection of Sul'phate of Cop'per. *Syn.* INJECTIO CUPRI SULPHATIS, L. *Prep.* 1. Sulphate of copper, 5 gr.; rose-water, 4 fl. oz. In chronic gonorrhœa.

2. (*Hunter.*) Sulphate of copper, 3 gr.; water, 4 fl. oz. As the last.

3. (*Swediaur.*) Sulphate of copper, 6 gr.; water, 4 fl. oz.; dissolve, and add solution of diacetate of lead, 20 drops. In phimosis.

Injection of Sul'phate of Ir'on. *Syn.* INJECTIO FERRI SULPHATIS, L. *Prep.* (*Berends.*) Sulphate of iron and mucilage, of each, ½ dr.; sage water, 4 fl. oz.; dissolve. In nasal and uterine hæmorrhages.

Injection of Sul'phate of Zinc, *Syn.* INJECTIO ZINCI SULPHATIS. *Prep.* 1. (Hosp. F.) Sulphate of zinc, 2 gr.; water, 1 fl. oz.

2. (King's Coll.: INJECTIO COMMUNIS.) *a.* Sulphate of zinc, 3 gr.; solution of lead, 20 drops; water, 1 fl. oz. For a man. *b.* Sulphate of zinc, 10 gr.; alum, 10 gr.; decoction of oak-bark, 1 fl. oz. For a woman.

INK. *Syn.* ATRAMENTUM, L. Coloured liquid employed for writing with a pen. Ink is made of various substances and colours; but at present we shall confine our attention to the tanno-gallic compounds, to which the term, when standing alone, is almost exclusively applied.

Prep. 1. Aleppo galls (well bruised), 4 oz.; clean soft water 1 quart; macerate in a clean corked bottle for 10 days or a fortnight, or even longer, with frequent agitation, then add of gum-arabic (dissolved in a wine-glassful of water, 1¼ oz.; lump sugar, ½ oz.; mix well, and afterwards further add of sulphate of iron (green copperas, crushed small), 1½ oz.; agitate occasionally for 2 or 3 days, when the ink may be decanted for use, but is better if the whole is left to digest together for 2 or 3 weeks. When time is an object, the whole of the ingredients may at once be put into a bottle, and the latter agitated daily until the ink is made; and boiling water instead of cold water may be employed.—*Prod.*, 1 quart of excellent ink, writing pale at first, but soon turning intensely black.

2. Aleppo galls (bruised), 12 lbs.; soft water, 6 galls.; boil in a copper vessel for 1 hour, adding more water to make up for the portion lost by evaporation; strain, and again boil the galls with water, 4 galls., for ½ an hour; strain off the liquor, and boil a third time with water, 2½ galls., and strain; mix the several liquors, and while still hot, add of green copperas (coarsely powdered), 4½ lbs.; gum-arabic (bruised small), 4 lbs.; agitate until dissolved, and after defæcation strain through a hair-sieve, and keep it in a bunged-up cask for use.—*Prod.*, 12 galls; very fine and durable.

3. Aleppo galls (bruised), 14 lbs.; gum, 5 lbs.; put them in a small cask, and add of boiling soft water, 15 galls.; allow the whole to macerate, with frequent agitation, for a fortnight, then further add of green copperas, 5 lbs., (dissolved in) water, 7 pints; and agitate the whole once daily for 2 or 3 weeks.—*Prod.* Fully 15 galls. Resembles No. 1.

4. Galls (bruised), 9 lbs.; logwood chips (best Campeachy), 3 lbs.; boil as in No. 2; to the strained mixed liquors, add of gum-arabic and green copperas, of each (bruised small), 4 lbs.; simmer or digest until dissolved, and at once strain through a hair-sieve into the store-cask or jars.—*Prod.*, 16½ galls. Excellent, but inferior to the preceding.

5. Galls (bruised), 2 lbs.; logwood chips, green copperas, and gum, of each, 1 lb.; water, 7 galls.; boil 2 hours and strain.—*Prod.*, 5 galls. A superior ink for retail.

6. Galls (bruised), 1 lb.; logwood, 2 lbs.; gum (common), 1 lb.; green copperas, ¾ lb.; water, 8 galls.; proceed as last.—*Prod.*, 6 galls. Common, but fit for all ordinary purposes.

For black ink, the following has been recommended:—Bruise 6 oz. of best Aleppo galls, and boil in 6 pints of water for several hours, adding more water to supply the loss by evaporation. Strain whilst hot through calico into a clean vessel. Add 4 oz. gum-arabic, and boil again till the gum is dissolved. Strain again whilst hot into a stone bottle, and add 4 oz. sulphate of iron, previously dissolved in water. Lastly, to preserve from going mouldy, add 3 drops of creosote for each pint of ink. To appear *thoroughly* black keep for some time before using.

The following formulæ are for some of the advertised inks, or are those recommended by the authorities whose names are attached to them:

7. (ANTI-CORROSIVE.) Same as 'Asiatic ink.'

8. (ASIATIC.) Galls, 4 lbs.; logwood, 2 lbs.; pomegranate peel, 2 lb.; soft water, 5 galls.; boil as in No. 2, then add to the strained and decanted liquor, when cold, of gum-arabic, 1 lb.; lump sugar or sugar candy, ¼ lb.; dissolved in water, 3 pints.—*Prod.*, 4½ galls. Writes pale, but flows well from the pen, and soon gets black.

9. (*Brande*). Galls, 6 oz.; green copperas and gum-arabic, of each, 4 oz.; soft water, 3 quarts; by decoction.

10. (*Chaptal.*) *a.* As No. 4 (nearly), adding sulphate of copper, ½ lb. Full coloured but less durable and anticorrosive than the preceding.

b. Another formula. Boil together 3 parts of crushed blue-galls and 1 part of Campeachy logwood (in chips) in 100 parts of water for 2 hours, keeping up the quantity of water by the addition of more at boiling temperature. Make a saturated solution of gum in warm water. Make a solution of *calcined* sulphate of iron, 1 part to 100. Of the

preparations thus made take 6 parts of the gall and logwood solution, 4 parts of the mucilage, and 4 parts of the iron solution, and mix together.

11. (*Desormeaux.*) Galls, 1 lb.; logwood chips, 4 oz.; water, 6 quarts; boil 1 hour, strain 5 quarts, add of sulphate of iron (calcined to whiteness), 4 oz.; brown sugar, 3 oz.; gum, 6 oz.; acetate of copper, ¼ oz.; agitate twice a day for a fortnight, then decant the clear, bottle, and cork up for use. Writes a full black, and otherwise resembles No. 10.

12. (*Elsner.*) Galls (powdered), 42 oz.; gum-senegal (powdered), 15 oz.; distilled or rain water, 18 quarts; sulphate of iron (free from copper), 18 oz.; liquor of ammonia, 3 dr.; spirit of wine, 24 oz.; mix these ingredients in an open vessel, stirring frequently until the ink attains the desired blackness. This formula is said to give a deep black neutral ink that does not corrode steel pens.

13. (EXCHEQUER.) Galls (bruised), 40 lbs. (say 4 parts); gum, 10 lbs. (say 1 part); green sulphate of iron, 9 lbs. (say 1 part); soft water, 45 galls. (say 45 parts); macerate for 3 weeks, employing frequent agitation. "This ink will endure for centuries."

14. (*Guibourt.*) Galls (in powder), 50 parts; hot water, 800 parts; digest 24 hours, strain, and add of green sulphate of iron and gum-arabic, of each, 25 parts; when dissolved, add the following solution and mix well:—Sal-ammoniac, 8 parts; gum, 2 parts; oil of lavender, 1 part; boiling water, 16 parts. Said to be indelible.

15. (JAPAN.) This is a black and glossy kind of ink, which may be prepared from either of the above receipts by calcining the copperas until white or yellow, or by sprinkling it (in powder) with a little nitric acid before adding it to the decoction (preferably the former), by which the ink is rendered of a full black as soon as made. The glossiness is given by using more gum. It flows less easily from the pen than other inks, and is less durable than ink that writes paler and afterwards turns black. It is unfitted for steel pens.

16. (*Lewis.*) Bruised galls, 3 lb.; gum and sulphate of iron, of each, 1 lb.; vinegar, 1 gall.; water, 9 quarts; macerate with frequent agitation for 14 days. To produce 3 galls. Fine quality, but apt to act on steel pens.

17. (*Payen.*) Crushed galls, 15 kilos.; sulphate of iron, 10 kilos.; gum-senegal, 20 kilos.; river water, 200 kilos. In a cylindrical copper boiler as deep as it is wide put the galls with 150 kilos. of water. Cover the boiler and raise the liquor to boiling, maintaining that temperature for 3 hours, and adding boiling water from time to time to replace that which is evaporated. At the end of the 3 hours draw off the liquor and let it deposit, and add to the clear solution the droppings from the marc on a filter. Separately dissolve the gum in as little warm water as will take it up, and add this to the gall decoction. In the remainder of the water dissolve the sulphate of iron, and stir this solution in with the rest. The liquor assumes a brown colour, which gradually becomes blacker. The inks should be kept in casks with the heads out, and stirred frequently with a spatula. It should be tried from time to time, and should not be allowed to become too black, or it will be less fluid. When the right colour is reached, the casks should be covered and left to deposit, the ink drawn off and put into earthenware bottles, well corked and sealed. The marc of the nut-galls from the above ink may be used with a ¼ or ½ quantity of fresh galls, some logwood or sumach, and the proportionable quantity of sulphate of iron and gum to make a second-quality ink.

18. (PREROGATIVE COURT.) Galls, 1 lb.; gum-arabic, 6 oz.; alum, 2 oz.; green vitriol, 7 oz.; kino, 3 oz.; logwood raspings, 4 oz.; soft water, 1 gall.; macerate as last. Said to write well on parchment.

19. (*Ribaucourt.*) Galls, 1 lb.; logwood chips and sulphate of iron, of each, ½ lb.; gum, 6 oz.; sulphate of copper and sugar-candy, of each, 1 oz.; boil the first two in soft water, 2½ galls., to one half, then add the other ingredients. Full coloured, but somewhat corrosive, as No. 10.

20. (*Dr Ure.*) Galls, 12 lbs.; green copperas and gum-senegal, of each, 5 lbs.; as No. 2 (nearly). To produce 12 galls.

21. (*Dr Wollaston.*) Galls, 1 oz.; sulphate of iron, 3 dr.; gum, ¼ oz.; cold water, ½ pint; put into a bottle and shake together every day for a fortnight or longer. A good durable ink, which will bear diluting.

22. ('Pharmaceutische Zeitung.') By adding ferrocyanide of potassium to ordinary ink an indelible writing ink may be obtained. The removal of such an ink by an acid would result in the production of Prussian blue.

Ink, Blue-black. The following formula is said to have been the original formula for a popular product made by an eminent Scotch firm:—Blue Aleppo galls (free from insect perforation), 4½ oz.; bruised cloves, 1 dr.; cold water, 40 oz.; purified sulphate of iron, 1½ oz.; pure sulphuric acid (by measure), 35 minims; sulphate of indigo (in the form of a thinnish paste, and which should be neutral, or nearly so), ¼ oz. Place the galls, when bruised, with the cloves in a 50-oz. bottle, pour upon them the water, and digest, with daily stirring, for a fortnight. Then filter through paper in another 50-oz. bottle. Get out, also, the refuse of the galls, and wring out of it the remaining liquor through a strong clean linen or cotton cloth into the filter, in order that as little as possible be lost. Next put in the iron, dissolve completely, and filter through paper; then the acid, and agitate briskly; lastly, the indigo, and thoroughly mix by shaking. Pass the whole through paper. Filter out of one bottle into the other till the operation has been completed. On a large scale this fine ink may be made by percolation. No gum or sugar is required, but when intended for copying, 5½ oz. of galls is the quantity. There are several peculiarities about this writing fluid, viz.:—First, the cold process is used; second, the absence of gum; third, the use of sulphate of indigo, which is a solvent for the black precipitate, the tanno-gallate of iron—hence the gum-arabic is not required, as it is only used to suspend this precipitate; fourth, the deficiency of iron, which may be accounted for by the pure protosulphate being used, which cannot contain,

or should not contain, any oxide, so that all the iron is free to combine with the tannin.

A great many formulæ for ink prescribe that the infusion of galls should be boiled and the sulphate of iron at once added. General experience points to the conclusion that a better colour is obtained by a long-continued maceration of the galls. China galls, which contain a much larger proportion of tannin than Aleppo galls, may be used in smaller proportion, but, as they do not contain the ferment which is naturally present in the Aleppo galls, a little yeast should be added to promote the conversion of the tannin.

Ink, a Blue-black, but one which appears violet at the time of writing, is made by bruising elder-berries, and setting them in a warm place for 3 days to ferment; straining and adding to each 6 pints of juice, ½ oz. sulphate of iron, and ½ oz. of acetic acid.

Inks, another Blue-black. Mr A. H. Allen, in 'Commercial Organic Analysis,' vol. 3, gives the following as the composition of Stephens's blue-black ink:—Galls, 15 parts; ferrous sulphate, 5 parts; iron filings, 4 parts; water, 200 parts; indigo, ½ part; sulphuric acid, 3 parts.

Inks, Cheaper, are made by substituting log-wood, catechu, sumach, or other tannic bodies for the whole or part of the nut-galls. A good process is the following:—Boil 22 lbs. of logwood in sufficient water to produce, after straining, 14 galls. of liquor. Add to the decoction 1 lb. of yellow chromate of potash (not bichromate) in solution. The product will become darker by keeping.

Ink, a Chemical. A really good and cheap blue-black ink may be made thus:—Aniline black 'B,' 2 oz.; gum-arabic, 2 oz.; acetic acid, 2 oz.; water, 1 gall.

Ink, Runge's, for Steel Pens. Runge's ink, which flows freely, and does not affect steel pens, is made by boiling 10 lbs. of logwood in 100 pints of water down to 80 pints. When cold, strain, and add 3 oz. of yellow chromate of potash, and stir well. No gum should be added to this ink, but the addition of 2 or 3 gr. of corrosive sublimate to each pint bottle will prevent its tendency to gelatinise.

General Commentary. According to the most accurate experiments on the preparation of black ink, it appears that the quantity of sulphate of iron should not exceed 1-3rd part of that of the galls, by which an excess of astringent vegetable matter, which is necessary for the durability of the colour, is preserved in the liquid. Gum, by shielding the writing from the action of the air, tends to preserve the colour; but if much is employed the ink flows languidly from quill pens, and scarcely at all from steel pens. The latter require a very limpid ink. The addition of sugar (especially of moist sugar) increases the flowing property of the liquid, but makes it dry more slowly and frequently to pass into an acetous state, in which condition it acts injuriously on the pen. Vinegar, for a like reason, is not calculated for the menstruum, as it rapidly softens quill or horn, and corrodes iron and steel.

To ensure the permanency of the colour of the tanno-gallic inks the best Aleppo or blue nut-galls must alone be used. No second or inferior quality should be employed. A contrary practice, often adopted for the sake of economy, is nearly always followed by unpleasant results, and often by considerable loss.

The only improvement of importance which has been made in the manufacture of writing ink from the common materials, during the last few years, is the practice of first roasting the gall-nuts, which is now adopted by a few of the houses most celebrated for their COPYING INK. In this way a portion of pyrogallic acid is formed, which is very soluble in water, and strikes an intense bluish-black colour with the protosulphate or green sulphate of iron. From galls so treated an ink may be made to write black at once. Care must, however, be taken to avoid any loss of materials by volatilisation.

To prevent any tendency to mouldiness in ink a few bruised cloves, or a little oil of cloves, or, still better, a few drops of creosote (carbolic acid) may be added. The last two should be previously dissolved in a small quantity of strong vinegar or rectified spirit. With the same intention some of the large makers allow the ink to become covered with a skin of 'mould' in the cask, to render it less liable to undergo the same change when subsequently bottled. Formerly the practice was to add a little spirit for the same purpose.

Sumach, logwood, and oak-bark are frequently substituted for galls in the preparation of common ink. When such is the case only about 1-6th or 1-7th of their weight of copperas should be employed. Inks so made possess little durability.

The very general use of steel pens of late years has caused a corresponding demand for easy-flowing inks, many of which are now vended under the titles of WRITING FLUIDS, STEEL-PEN INK, ANTICORROSIVE INK, &c. The greater number of these are prepared from galls in the preceding manner; but a less quantity of gum is employed, and greater attention is paid than heretofore to avoid every source of 'greasiness,' among which smoke and dirty utensils are, perhaps, the principal. The blue 'writing fluids,' which either maintain their colour or turn black by exposure to the air, are in general prepared from ferrocyanide of potassium, or from indigo, and are fully noticed in another place. COPYING INK, another variety of ink of recent introduction, is characterised by its suitableness to metallic pens, and by furnishing a transcript by means of the 'copying press' or 'copying machine' (see *below*).

The inks prepared by the first four of the above formulæ are very durable and limpid, and will bear dilution with nearly an equal bulk of water, and still be superior in quality to the ordinary inks of the shops. See GALLS, IRON, WRITING FLUID, and *below*.

Metal inkstands are likely to decompose most inks.

To restore the colour to faded writing wash very carefully with an infusion of nut-galls.

A violet tint is imparted to ink by the addition to it of a little carbonate of manganese.

M. Mathieu Plessy, in a treatise on inks, says that the employment of galls and sulphate of iron is essentially a bad process; inks made from these ingredients must deposit and will inevitably fade in time. He has made inks which are said to be

very good, and though his process has not been published, it is understood to be based on the combination of pyrogallic acid with the colouring matter of Brazil-wood.

The formation of mould on inks is prevented by the addition of ½ oz. of crushed cloves for every pound of galls; or equally by the addition to the prepared ink of a minute pinch of red precipitate (about 5 gr. to the pint). Nitro-benzole, creosote, and carbolic acid are also used for the purpose.

INKS (Coloured). Inks of various colours may be made from a strong decoction of the ingredients used in dyeing, mixed with a little alum or other substance used as a mordant, and gum-arabic. Any of the ordinary water-colour cakes employed in drawing, diffused through water, may also be used as coloured ink. See BROWN, GREEN, and RED inks, &c.

Inks, Aniline. Inks made with aniline colours are very rich in tint, but they are likely to fade. The usual process of making them is to dissolve ½ oz. of the solid dye in 5 oz. of strong alcohol, let it stand in a covered vessel for about 3 hours, then add about 35 oz. of distilled water, and heat gently for some hours until the odour of alcohol is no longer perceptible. Add to the liquor 8 oz. of distilled water in which 2 oz. of gum has been previously dissolved.

A formula for an aniline ink, which, it is said, preserves its colour for a long time, is the following:—Aniline violet, red, or blue, 20 parts; gluten or gum, 100 parts; water, 1000 parts; acetic acid, 100 parts.

A black aniline ink is prepared by rubbing 60 gr. of aniline-black with 60 drops of hydrochloric acid and 1½ oz. of alcohol. This solution is diluted with 3 oz. of distilled water in which ¼ oz. of gum has been dissolved.

Ink, for Blue, the following is said to be good:—To 1000 parts of boiled water add 30 parts of Prussian blue dissolved in 4 parts of oxalic acid.

Ink, Blue and Blue-black. See WRITING FLUID.

Ink, Cheap Blue. *Prep.* Best logwood, 1¼ lbs.; alum, 1 oz.; gum-arabic, 1 oz.; sugar-candy, ½ oz.; water, 10 pints. Boil for an hour, let it stand for 2 or 3 days, and strain through linen.

Ink, Bichromate. *Prep.* Extract of logwood, 100 parts; lime-water, 800 parts; carbolic acid, 3 parts; crude hydrochloric acid, 25 parts; distilled water, 600 parts; gum-arabic, 30 parts; bichromate of potash, 3 parts; distilled water, to make 1800 parts. The ink should be made in a porcelain or enamelled iron vessel. The extract is first dissolved in the lime-water over a steam-bath with constant stirring. To these are added the carbolic and hydrochloric acids, which change the solution from a red to a brownish-yellow colour. After half an hour's heating over the steam-bath, the mixture is set aside till cold, when it is strained or filtered. Lastly, the gum and the bichromate, each separately dissolved in a considerable quantity of water, are added, and the remainder of the water to make up the necessary weight.

According to some, 2 or 3 times the quantity of bichromate should be used in order to bring up the colour, but it should be noted that the colour of the ink is to be dark red.

Ink, Brown. *Prep.* 1. A strong decoction of catechu; the shade may be varied by the cautious addition of a little weak solution of bichromate of potash.

2. A strong decoction of logwood, with a very little bichromate of potash.

Ink, Carbon. *Prep.* Dissolve real Indian ink in common black ink, or add a small quantity of lamp-black previously heated to redness, and ground perfectly smooth, with a small portion of the ink.

Ink, Carmine. *Prep.* 1. Heat 1 scr. of carmine with 4 oz. of water of ammonia for some minutes, a little below boiling, and add 15 to 20 gr. of gum. (The inkstand must be kept well closed.)

2. Carmine rubbed in a mortar with soluble glass (silicate of soda) and diluted with distilled water, and preserved in full tightly-corked bottles, makes an ink of a brilliant colour.

Ink, Chrome. See GREEN INK and WRITING FLUID.

Ink, Cochineal. *Prep.* Rub together powdered cochineal, ½ oz.; carbonate of soda, 1 oz.; distilled water, 13 oz. Mix these in a large mortar capable of holding 3 or 4 pints, and stir frequently during 2 days. Then add cream of tartar, ¾ oz.; alum, ⅜ oz. Warm gently, and stir until all the carbonic acid has passed away. Add gum-arabic, ¾ oz.; alcohol, ½ oz. Filter and make up the solution to 15 oz. with distilled water. The ink should be at once bottled in small vials, and should be kept well corked.

Ink, Eosin, is often spoken of as a good red ink; but, according to a correspondent of the 'Pharmaceutische Zeitung,' ordinary eosin does not give such good results as erythrosin, having a blue or yellow shade. A 1% solution of this is strong enough.

Ink, Gold. From gold in the state of an impalpable powder, ground up with a little gum-water. The brilliancy of the writing performed with this ink is considerable, and may be increased by burnishing.

Ink, Green. *Prep.* 1. From sap-green dissolved in very weak alum water.

2. A strong solution of binacetate of copper in water, or of verdigris in vinegar.

3. (*Klaproth.*) Verdigris, 2 oz.; cream of tartar, 1 oz.; water, ½ pint; boil to one half, and filter.

4. (*Winckley.*) Bichromate of potassa, 3 parts; hot water, 8 parts; dissolve, add of rectified spirits, 4 parts, mix, and further add of sulphuric acid, q. s. to liberate the chromic acid, avoiding excess; next evaporate to one half, dilute with water, filter, and add to the filtrate rectified spirit, 4 parts, together with 3 or 4 drops of sulphuric acid (if required), to precipitate any remaining potash salt; lastly, decant and preserve the liquid until it assumes a rich green colour.

5. A solution of recently precipitated hydrated oxide of chromium in liquor of ammonia, diluted with distilled water, q. s. A magnificent dark green liquid, perfectly anticorrosive.

Ink, Prussian-blue. This is made by dissolving 1 oz. of soluble Prussian blue in 8 oz. of water in which 1 oz. of oxalic acid has been previously added. It is a very permanent ink, but it is

liable to attack steel pens, and may eat into the paper.

Another formula. A pure Prussian blue dissolved in distilled water by the aid of oxalic acid, and thickened by gum. Prussian blue is generally contaminated with oxide of iron, and this should be removed by a careful washing with sulphuric acid. For solution of the pure prussiate about 1-6th of its weight of oxalic acid is necessary.

Ink, Pur′ple. *Prep.* 1. A strong decoction of logwood, to which a little alum or chloride of tin has been added.

2. (*Normandy.*) To 12 lbs. of Campeachy wood add as many gallons of boiling water, pour the solution through a funnel with a strainer made of coarse flannel, or 1 lb. of hydrate or acetate of deutoxide of copper finely powdered (having at the bottom of the funnel a piece of sponge); then add immediately 14 lbs. of alum, and for every 340 galls. of liquid add 80 lbs. of gum-arabic or gum-senegal. Let these remain for 3 or 4 days, and a beautiful purple colour will be produced.

Ink, Red. *Prep.* 1. Brazil-wood (ground), 4 oz.; white-wine vinegar (hot), $1\frac{1}{4}$ pints; digest in glass or a well-tinned copper or enamel saucepan until the next day, then gently simmer for $\frac{1}{2}$ an hour, adding towards the end, gum-arabic and alum, of each, $\frac{1}{2}$ oz.

2. Ground Brazil-wood, 10 oz.; white vinegar, 10 pints; macerate for 4 or 5 days; then boil as before to one half, and add of roche alum, $4\frac{1}{2}$ oz.; gum, 5 oz.; and when dissolved, bottle for use.

3. As the last, but using water or beer instead of vinegar.

4. Cochineal (in powder), 1 oz.; hot water, $\frac{1}{2}$ pint; digest, and when quite cold, add of spirit of hartshorn, $\frac{1}{4}$ pint (or liquor of ammonia, 1 oz., diluted with 3 or 4 oz. of water); macerate for a few days longer, and then decant the clear. Very fine.

5. (*Buchner.*) Pure carmine, 20 gr.; liquor of ammonia, 3 fl. oz.; dissolve, then add of powdered gum, 18 gr. Half a drachm of powdered drop lake may be substituted for the carmine where expense is an object. Colour superb.

6. (*Henzeler.*) Brazil-wood, 2 oz.; alum and cream of tartar, of each, $\frac{1}{2}$ oz.; rain-water, 16 fl. oz.; boil to one half, strain, add of gum (dissolved), $\frac{1}{2}$ oz.; and when cold, further add a tincture made by digesting powdered cochineal, $1\frac{1}{2}$ dr., in rectified spirit, $1\frac{1}{2}$ fl. oz.

7. (*Redwood.*) Guarancine and liquor of ammonia, of each, 1 oz.; distilled water (cold), 1 pint; triturate together in a mortar, filter, and dissolve in the solution, gum-arabic, $\frac{1}{2}$ oz.

Ink, a Red, which, it is said, will not lose its brilliancy by use with steel pens, is made as follows:—Grind 1 part carmine with 15 parts acetate ammonia and 15 parts water. These are allowed to stand for some time, strained, and then thickened with a few drops of dissolved white sugar.

Ink, Cheap Red. *Prep.* Brazil-wood, 4 oz.; cream of tartar, 1 oz.; alum, 1 oz.; water, 3 pints. Boil down to half and add, while hot, 1 oz. of gum, and (if for copying) 1 oz. of sugar.

Ink, Se′pia. See SEPIA.

Ink, Sil′ver. From silver leaf or powdered silver, as GOLD INK.

Ink, Vi′olet. The same as PURPLE INK, but weaker.

Ink, White. *Prep.* 1. Powder very white and clean egg-shells in a mortar with clean water; pour off the water and dry the powder in the sun.

2. Take white pieces of gum-ammoniac, wash and remove from them all pieces of yellow skin. Dissolve this gum in acetic acid during a night; strain through a clean piece of linen, and add to the solution a sufficient quantity of the finely powdered egg-shells. This will give a very brilliant white ink for writing on black paper.

3. Solution of potash with a little syrup or mucilage makes a white ink for writing on blue paper.

Ink, Yel′low. *Prep.* 1. From gamboge (in coarse powder), 1 oz.; hot water, 5 oz.; dissolve, and when cold, add of spirit, $\frac{3}{4}$ oz.

2. Boil French berries, $\frac{1}{2}$ lb., and alum, 1 oz., in rain-water, 1 quart, for half an hour or longer, then strain and dissolve in the hot liquor gum-arabic, 1 oz.

INK (Copying). This is usually prepared by adding a little sugar or other saccharine matter to ordinary black ink, which for this purpose should be very rich in colour, and preferably made with galls prepared by heat, as noticed above. Writing executed with this ink may be copied within the space of 5 or 6 hours, by passing it through a press (COPYING PRESS) in contact with thin unsized paper (BANK POST), slightly damped, enclosed between two sheets of thick oiled or waxed paper, when a reversed transcript will be obtained, which will read in proper order when the back of the copy is turned upwards. In the absence of a press a copy may be taken, when the ink is good and the writing very recent, by rolling the sheets, duly arranged on a ruler, over the surface of a flat smooth table, employing as much force as possible, and avoiding any slipping or crumbling of the paper. Another method is to pass a warm flat-iron over the paper laid upon the writing. The following proportions are employed.

Prep. 1. Sugar-candy or lump sugar, 1 oz.; or treacle or moist sugar, $1\frac{1}{4}$ oz.; rich black ink, $1\frac{1}{2}$ pints; dissolve.

2. Malt wort, 1 pint; evaporate it to the consistence of a syrup, and then dissolve it in good black ink, $1\frac{1}{4}$ pints.

3. Solazza juice, 2 oz.; mild ale, $\frac{1}{2}$ pint; dissolve, strain, and triturate with lamp-black (previously heated to dull redness in a covered vessel), $\frac{1}{4}$ oz.; when the mixture is complete, add of strong black ink, $1\frac{1}{2}$ pints, mix well, and in 2 or 3 hours decant the clear.

Obs. After making the above mixtures, they must be tried with a common steel pen, and if they do not flow freely, some more unprepared ink should be added until they are found to do so.

4. Nut-galls, 6 oz.; alum, $\frac{1}{2}$ oz.; Brazil-wood, $\frac{1}{2}$ oz.; sugar, $\frac{1}{2}$ oz.; sour beer, 1 gall. Infuse this mixture for 24 hours in a glazed earthenware vessel, frequently stirring it; raise it to boiling temperature, and boil down to 2-3rds of its original volume. Strain and add $1\frac{1}{2}$ oz. powdered sulphate

of iron. Let it stand some days in the sun, and afterwards bottle.

5. Chinese blue affords the best solution. Take 2 oz. of it in powder and 1 oz. of oxalic acid, mix together and make into a thin paste with boiling water; when thoroughly uniform make up to 30 oz., or more, according to strength required, with boiling water. This makes a permanent solution, and, with a little mucilage added, a very good ink.

6. Sugar is used for copying ink, or equal parts of sugar and gum-arabic.

Ink, Red Copying. *Prep.* Dissolve 50 parts of extract of logwood in a mortar in 750 parts of distilled water without the aid of heat; add 2 parts of chromate of potassium and set aside. After 24 hours add a solution of 3 parts of oxalic acid, 20 parts of oxalate of ammonium, and 40 parts of sulphate of aluminium in 200 parts of distilled water, and again set aside for 24 hours. Now raise it once to boiling in a bright copper kettle, add 50 parts of vinegar, and, after cooling, fill into bottles and cork. After a fortnight decant. This ink is red in thin layers, writes red, gives excellent copies in brownish colour, and turns blackish brown upon the paper.

Ink, Violet Copying. *Prep.* Dissolve 40 parts of extract of logwood, 5 of oxalic acid, and 30 parts of sulphate of aluminium, without heat, in 800 parts of distilled water and 10 parts of glycerin; let stand 24 hours; then add a solution of 5 parts of bichromate of potassium in 100 parts of distilled water, and again set aside for 24 hours. Now raise the mixture once to boiling in a bright copper boiler, mix with it, while hot, 50 parts of wood-vinegar, and, when cold, put into bottles. After a fortnight decant it from the sediment. In thin layers this ink is reddish violet; it writes dark violet, and furnishes bluish-violet copies.

Inks, Copying. *Prep.* Use one of the formulæ given above for a nut-gall ink, but substitute glycerin for 10% of the water. For a red copying ink dissolve ½ oz. of fuchsine in 30 oz. water, and add ½ fl. oz. of glycerin or 10 dr. of gum-arabic. For a violet copying ink dissolve ½ oz. of methyl-violet in 16 oz. of water, and add ½ fl. oz. of glycerin or 10 dr. of gum-arabic. A few drops of creosote should be added to these inks to make them keep.

Ink, Etching, for Glass. In 'Neu. Erfind. und Erfahr.' Dr Muller describes the process of making a fluorine ink for etching. *Prep.* 1. Mix equal parts of hydrofluoric acid, fluoride of ammonia, and dry precipitated barium sulphate in a porcelain mortar. Transfer the mixture to a platinum, lead, or gutta-percha dish, and add fuming hydrofluoric acid, stirring with a gutta-percha pestle until the impression of the pestle quickly disappears. The quality of the barium sulphate is important; it must be prepared by precipitating from a solution of the chloride by sulphuric acid. The ink must be preserved in gutta-percha bottles, and be shaken before use. Care must be taken to keep it from contact with the skin. The corks should be protected with wax or paraffin.

2. A solution of fluoride of ammonium (must be kept in gutta-percha bottles).

3. Asphalt dissolved in turpentine.

4. Amber varnish containing a sufficient quantity of lamp-black.

Ink, Extract of. *Prep.* Extract of logwood, 5 parts; yellow chromate of potash, 1 part. ½ oz. of this extract is sufficient to make a quart of ink.

Inks, Hæmatin. Hæmatin, according to the makers, "is the colouring matter of logwood in its greatest purity. As it is free from resinous and other impurities, it gives much more brilliant shades, and it also works much more regularly than decoctions of logwood or logwood extract. Some articles are offered as hæmatin which are only logwood extracts, but the genuine article should contain over 99% of pure colouring matter." For a number of years hæmatin has been a marketable commodity, the American variety, according to Reinhard, containing 51% of hæmatoxylin, 10% of hæmatin, 17% of insoluble matter, and 20% of water.

The advantages which hæmatin possesses over logwood extract in the preparation of writing inks are its ready solubility and the pleasant fluidity of the finished ink. Its disadvantages are the readiness with which its hæmatin is decomposed by heating, and the lack of lustre which characterises the ink. We may state that the colouring principle of logwood, hæmatoxylin, is *per se* a yellowish substance, which, by oxidation, is changed into the purple-coloured hæmatin. The heart-wood of *Hæmatoxylon campeachianum* is of a dark yellow colour, and assumes the purple hue with which we are familiar by exposure to the air and fermentation. Then the glucoside hæmatoxylin is changed into hæmatin, and, in making logwood ink, the object is to continue that change, and to further oxidise the hæmatin, or to form a purple-coloured hæmatinate of an alkali. This, in brief, is the chemistry of the subject, but we may state further that excessive oxidation of hæmatin during the preparation of ink is followed by destruction of the purple colour (most of the hæmatinates become brown on exposure), and excessive muddiness, due to the formation of resinous matter.

Ink, Alkaline Hæmatin. *Prep.* 1. Take of hæmatin, 2 dr.; distilled water, 15 oz. Put into a pint bottle, and keep at a temperature between 60° and 70° F. for 2 hours, shaking frequently; at the end of that time decant the clear solution, heat to 100° F., and add crystallised carbonate of soda, ½ dr.; dissolve. When cool, add yellow chromate of potash, 4 gr. Dissolve in 1 oz. of water. This solution must be added drachm by drachm, stirring assiduously all the time. Then add the following:—Gum-acacia, 3 dr.; carbolic acid, 5 gr.; distilled water, 2 dr. Shake well, and make up to 20 oz. with distilled water.

This ink is of a beautiful violet-black colour, and writes jet-black. It is perfectly fluid.

2. The next formula is a modification of Schmieden's ('Pharm. Zeitung,' 1882). Take of hæmatin, 4 dr.; distilled water, 16 oz. Dissolve by a gentle heat (not exceeding 120° F.), and add potash alum, 4 dr. Stir well until dissolved, then remove from the heat and add strong sulphuric acid, 80 drops; then, with constant stirring, add a solution of yellow chromate of potash, ½ dr., in distilled water, 2 oz. Now dissolve 40 gr. of ferrous sulphate in 1 oz. of water, add 2 dr. of crude hydrochloric acid, and mix this solution with the preceding one; make up to 20 oz., put

in 40 gr. of gum-arabic, shake occasionally during 4 hours, then set aside for a day to settle, after which decant from the sediment.

This ink is of a dark red colour, and writes the same. If anything, it is a little thicker than the alkaline one; it is very pleasant to write with, however, and we may caution experimenters not to be disappointed when they behold the various transitions of colour which the writing undergoes. At one stage it becomes brown, but in 12 hours it is perfectly jet-black.

Ink, Horticul′tural. To write on zinc labels. *Prep.* 1. Chloride of platinum, ¼ oz.; soft water, 1 pint; dissolve, and preserve it in glass. Used with a clean quill to write on zinc labels. It almost immediately turns black, and cannot be removed by washing. The addition of gum and lamp-black, as recommended in certain books, is unnecessary, and even prejudicial to the quality of the ink.

a. Dissolve chloride of platinum, 1 part, and gum-arabic, 1 part, in distilled water, 12 parts. This should be used with a quill, and the zinc should be first cleaned with hydrochloric acid and sand. The writing, which will be a deposit of platinum-black, will appear as a velvety black. If when freshly written the plate is dipped into a solution of cyanide of gold and potassium, and afterwards into a dilute nitric acid (1 to 16), a permanent gold film will cover the writing, which cannot be removed even by acids (*Böttger*).

b. Dissolve 100 gr. of tetrachloride of platinum in a pint of water. A little mucilage and lamp-black may be added.

2. Verdigris and sal-ammoniac, of each, ½ oz.; levigated lamp-black, ½ oz.; common vinegar, ¼ pint; mix thoroughly. Used as the last, for either zinc, iron, or steel.

a. Verdigris, 2 parts; sal-ammoniac, 4 parts; lamp-black or animal charcoal, 1 part; water, 20 parts. First make the powders into a paste, and then add the rest of the water. Shake before using (*Braconnot*).

b. Sal-ammoniac, 1 dr.; verdigris, 1 dr.; lamp-black, ½ dr.; water, 10 dr.; mix.

3. Blue vitriol, 1 oz.; sal-ammoniac, ½ oz. (both in powder); vinegar, ¼ pint; dissolve. A little lamp-black, or vermilion, may be added, but it is not necessary. As No. 1; for iron, tin, or steel plate. Some of the preparations described under 'INCORRODIBLE INK' are also used by gardeners and nurserymen.

4. A solution of sulphate of copper, slightly thickened with gum, and carrying some sort of lamp-black in suspension (*Grassi*).

Ink, Incorro″dible. This name has been given to several preparations of a resinous character, capable of resisting the action of damp and acids. *Prep.* 1. Boiled linseed oil, ground with lamp-black and Prussian blue, of each, q. s. to impart a deep black colour. It may be thinned with oil of turpentine.

2. Good copal or amber varnish, coloured with either plumbago or vermilion.

3. Trinidad asphaltum (genuine), 1 part; oil of turpentine, 4 parts; colour (as last), q. s.

4. (*Close.*) Cobalt (in powder), 25 gr.; oil of lavender, 200 gr.; dissolve by a gentle heat, and add of lamp-black, 3 gr.; indigo, 1 gr. (both in impalpable powder); or vermilion, q. s.

5. (*Hausmann.*) As No. 3 (nearly). Resists the action of iodine, chlorine, alkalies, and acids.

6. (*Sheldrake.*) Asphaltum dissolved in amber varnish and oil of turpentine, and coloured with lamp-black.

Coarsely powdered anacardium nuts (the fruit of the *Anacardium orientale*) are macerated in a well-closed bottle with petroleum ether for some time. Upon allowing the latter to evaporate spontaneously, a syrupy residue is left, and this, when applied to linen or cotton cloth, imparts to it a brownish-yellow colour, which instantly changes to a deep black on the addition of ammonia or lime-water (*Böttger*).

Obs. The above are also frequently called 'indelible' or 'indestructible' inks. They are employed for writing labels on bottles containing strong acids and alkaline solutions. The last 5 are very permanent, and are capable of resisting the action of iodine, chlorine, alkaline lyes, and acids, together with all the operations of dyeing and bleaching, and at once offer a cheap and an excellent material for marking linen, &c., as they cannot be dissolved off by any menstrua that will not destroy the fabric. They must be employed with stamps, types, or stencil plates, by which greater neatness will be secured than can be obtained with either a brush or pen. See HORTICULTURAL INK, INDELIBLE INK, &c.

Ink, Indel′ible. *Syn.* INDESTRUCTIBLE INK. *Prep.* 1. Lamp-black (previously heated to dull redness in a covered vessel), ¼ oz.; triturate with good black ink (gradually added), 1 pint. Resists chlorine, weak acids, and weak alkaline lyes, in the cold.

2. (*Bezanger.*) Lamp-black ground in a lye of caustic soda, combined with a mixture of gelatin and caustic soda. Said to be indelible, and to resemble genuine China ink.

3. (*Braconnot.*) Dantzic potash, 4 parts; tanned leather parings, 2 parts; sulphur, 1 part; water, 20 parts; boil them in an iron vessel to dryness, then raise the heat (constantly stirring with an iron rod) until the whole forms a soft mass, observing that it does not ignite; next dissolve the mass in water, q. s., and filter the solution through a cloth. Flows freely from a pen, and resists the action of many chemical substances.

4. (CARBON INK.) Genuine Indian ink rubbed down with good black ink until it will flow easily from a pen. Resists chlorine, oxalic acid, and ablution with a hair-pencil or sponge.

5. (*Coathupe.*) Borax, 1 oz.; shell-lac, 2 oz.; water, 18 fl. oz.; boil in a covered vessel until dissolved, strain; add of thick mucilage, 1 oz., and triturate it with levigated indigo and lamp-black, of each, q. s. to give a good colour. After 2 hours' repose, decant it from the dregs, and bottle for use. Resists moisture, chlorine, and acids.

6. (FRENCH.) *a.* From Indian ink diffused through water acidulated with hydrochloric acid. For quills.

b. From Indian ink diffused through water slightly alkalised with liquor of potassa. For metallic pens.

7. (*Herberger.*) Wheat-gluten (free from starch), q. s., is dissolved in weak acetic acid or

good pure vinegar, 4 fl. oz.; lamp-black (best), 10 or 12 gr.; indigo, 2 or 3 gr.; and oil of cloves, 1 or 2 drops, are then added, and the whole is thoroughly incorporated together. The product is inexpensive, has a beautiful black colour, and resists the action of water, chlorine, and weak acids.

Obs. The products of the above formulæ, though called 'indelible ink' and 'indestructible ink,' are in reality only indelible as compared with common writing ink, as they may all be removed with more or less facility by chemical reagents, assisted by mechanical means. They are intended chiefly for paper, pasteboard, and parchment. No. 5 is also used for glass and metal. See MARKING INK.

Inks, Indelible. A great many experimenters have sought to produce an ink which should resist all attempts to remove it by chemical means. Nothing more satisfactory, on the whole, has been found than a solution of Chinese (or so-called Indian) ink in acidulated or alkaline water. Hydrochloric acid is used for the acid solution, and caustic soda for the alkaline water. The latter only is suitable for steel pens. The proportion of acid or alkali must vary according to the paper on which the ink is to be applied. The object is to get an ink which shall sufficiently penetrate the paper so that it cannot be removed by mechanical means. Indian ink is a preparation of carbon in a very fine state of division, and this is not affected by any chemical. Another indelible ink is made as follows:—Add borax to boiling water to saturation. To the solution add as much brown gum-lac as it will dissolve. To this mixture add lamp-black. Ink thus made cannot be removed by chemicals, and presents a beautiful polish when written with.

An indelible aniline ink may be made by rubbing 60 gr. of aniline-black with 60 drops of strong hydrochloric acid, and 1 oz. of alcohol. This yields a deep blue liquid which can be diluted with 3 oz. of water in which $\frac{3}{4}$ oz. gum has been dissolved.

Certain safety papers have been invented, the object of which has been to introduce a chemical into the paper which should yield a black compound with the liquid used as ink, thus so fixing the characters that they can only be removed by the destruction of the paper. Bellande's patent consisted in the combination with the paper of calomel, or of a salt of iron, copper, or lead. Calomel was considered preferable. If combined with the pulp, 25% of the weight of the latter was added, or about 4% if fixed to the surface of the manufactured paper by gums or gelatins. The ink recommended was 25 parts of prussiate of potash and 25 parts of hyposulphate of soda in 100 parts of a thin solution of gum.

Ink, In'dian. *Syn.* CHINA INK; ATRAMENTUM INDICUM, L. *Prep.* 1. Lamp-black (finest) is ground to a paste with very weak liquor of potassa, and this paste is then diffused through water slightly alkalised with potassa, after which it is collected, washed with clean water, and dried; the dry powder is next levigated to a smooth, stiff paste, with a strong filtered decoction of carrageen or Irish moss, or of quince seed, a few drops of essence of musk, and about half as much essence of ambergris being added, by way of perfume, towards the end of the process; the mass is, lastly, moulded into cakes, which are ornamented with Chinese characters and devices as soon as they are dry and hard.

2. A weak solution of fine gelatin is boiled at a high temperature in a Papin's digester for 2 hours, and then in an open vessel for 1 hour more; the liquid is next filtered and evaporated to a proper consistence, either in a steam or salt-water bath; it is, lastly, made into a paste, as before, with pure lamp-black which has been previously heated to dull redness in a well-closed crucible. Neither of the above gelatinises in cold weather, like the ordinary imitations.

3. (*Gray.*) Pure lamp-black made up with asses'-skin glue, and scented with musk.

4. (*Merimée.*) Dissolve superfine glue in water, add a strong solution of nut-galls, and wash the precipitate in hot water; then dissolve it in a fresh solution of glue, filter, evaporate to a proper thickness, and form it into a paste as before, with purified lamp-black.

5. (*Proust.*) As No. 1 (nearly).

6. Seed-lac, $\frac{1}{2}$ oz.; borax, $1\frac{1}{2}$ dr.; water, $\frac{1}{2}$ pint; boil to 8 oz., filter, and make a paste with pure lamp-black, as before. When dry, it resists the action of water.

Obs. The Chinese do not use glue in the preparation of their ink, but an infusion or decoction of certain seeds abounding in a glutinous transparent mucilage, which at once imparts brilliancy and durability to the colour. Starch converted into gum by means of sulphuric acid, or 'British gum,' has been recommended as a substitute (*M. Merimée*). Indian ink is chiefly employed by artists, but it has been occasionally given as a medicine, dissolved in water or wine, in hæmorrhages and stomach complaints.—*Dose,* 1 to 2 dr.

Ink, Lithograph'ic. *Prep.* 1. Mastic (in tears), 8 oz.; shell-lac, 12 oz.; Venice turpentine, 1 oz.; melt together, add, of wax, 1 lb.; tallow, 6 oz.; when dissolved, further add of hard tallow soap (in shavings), 6 oz.; and when the whole is perfectly combined add of lamp-black, 4 oz.; lastly, mix well, cool a little, and then pour it into moulds, or upon a slab, and when cold cut into square pieces.

2. (*Lasteyrie.*) Dry tallow soap, mastic (in tears), and common soda (in fine powder), of each, 30 parts; shell-lac, 150 parts; lamp-black, 12 parts; mix as last. Both the above are used for writing on lithographic stones.

3. (AUTOGRAPHIC.) *a.* Take of white wax, 8 oz., and white soap, 2 to 3 oz.; melt, and when well combined, add of lamp-black, 1 oz.; mix well, heat it strongly, and then add of shell-lac, 2 oz.; again heat it strongly, stir well together, cool a little, and pour it out as before. With this ink lines may be drawn of the finest to the fullest class, without danger of its spreading, and the copy may be kept for years before being transferred.

b. From white soap and white wax, of each, 10 oz.; mutton suet, 3 oz.; shell-lac and mastic, of each, 5 oz.; lamp-black, $3\frac{1}{2}$ oz.; mix as above. Both the above are used for writing on lithographic paper. When the last is employed, the transfer must be made within a week.

Obs. The above inks are rubbed down with a little water in a small cup or saucer for use, in the same way as common water-colour cakes or Indian ink. In winter the operation should be performed near the fire, or the saucer should be placed over a basin containing a little tepid water. Either a steel pen or a camel-hair pencil may be employed with the ink. See LITHOGRAPHY.

INK (Mark'ing). *Syn.* INDELIBLE INK, PERMANENT I. Of this there are several varieties, of which the following are the most valuable and commonly used:

Prep. 1. Nitrate of silver, ¼ oz.; hot distilled water, 7 fl. dr.; dissolve, add of mucilage, ¼ oz.; previously rubbed with sap-green or syrup of buckthorn, q. s. to colour. The linen must be first moistened with 'liquid pounce,' or 'the preparation,' as it is commonly called, and when it has again become dry, written on with a clean quill pen. The ink will bear dilution if the writing is not required very black.

The POUNCE or PREPARATION. A solution of carbonate of soda, 1½ oz., in water, 1 pint, slightly coloured with a little sap-green or syrup of buckthorn, to enable the spots wetted with it to be afterwards known.

2. (WITHOUT PREPARATION.) Take of nitrate of silver, ¼ oz.; water, ¾ oz.; dissolve, add as much of the strongest liquor of ammonia as will dissolve the precipitate formed on its first addition; then further add of mucilage, 1½ dr., and a little sap-green, syrup of buckthorn, or finely powdered indigo, to colour. Writing executed with this ink turns black on being passed over a hot Italian iron, or held near the fire.

3. Terchloride of gold, 1½ dr.; water, 7 fl. dr.; mucilage, 2 dr.; sap-green, q. s. to colour. To be written with on a ground prepared with a weak solution of protochloride of tin, and dried. Dark purple.

4. (*Rev. J. B. Reade.*) Nitrate of silver, 1 oz., tartaric acid (pure), 3 dr., are triturated together in a mortar in the dry state; a little water is then added, by which crystals of tartrate of silver are formed, and the nitric acid set free; the latter is then saturated with liquor of ammonia, sufficient being added to dissolve all the newly formed tartrate of silver, avoiding unnecessary excess; lastly, a little gum and colouring matter is added.

5. (*Rev. J. B. Reade.*) To the last is added an ammoniacal solution of a salt of gold. Mr Reade has used for this purpose the 'purple of Cassius,' the hyposulphite, the ammonio-iodide, the ammonio-periodide of gold, but any other compound of gold which is soluble in ammonia will do as well. This ink is unacted on by nearly all those reagents which remove writing executed with solutions of the salts of silver alone, as cyanide of potassium, the chlorides of lime and soda, &c.

6. (*Redwood.*) Nitrate of silver and pure bitartrate of potassa, of each, 1 oz. (or 4 parts), are rubbed together in a glass or Wedgwood-ware mortar, and after a short time liquor of ammonia, 4 oz. (16 parts, or q. s.), is added; when the solution is complete, archil, 4 dr. (or 2 parts); white sugar, 6 dr. (or 3 parts); and powdered gum, 10 dr. (or 5 parts), are dissolved in the liquor, after which sufficient water is added to make the whole measure exactly 6 fl. oz., when it is ready to be bottled for use. The last three are used in the same manner as No. 2.

7. (*Dr Smellie.*) From sulphate of iron, 1 dr.; vermilion, 4 dr.; boiled linseed oil, 1 oz.; triturated together until perfectly smooth. Used with type.

8. (*Soubeiran.*) Nitrate of copper, 3 parts; carbonate of soda, 4 parts; nitrate of silver, 8 parts; mix, and dissolve in liquor of ammonia, 100 parts. Used like No. 2.

9. (*Ure.*) A strong solution of chloride of platinum, with a little potassa and sugar and gum to thicken.

10. The fluid contained between the kernel and shell of the cashew-nut. On linen and cotton it turns gradually black, and is very durable. This has been called ANACARDIUM, or CASHEW-NUT INK.

11. Sulphate of manganese, 2 parts; lamp-black, 1 part; sugar, 4 parts; all in fine powder, and triturated to a paste with a little water. Used with types or stencil-plates; the part, when dry, being well rinsed in water (*Brown*).

12. Black oxide of manganese and hydrate of potassa are mixed, heated to redness in a crucible, and then triturated with an equal weight of pure white clay, and water, q. s. to give it due consistence. Used like the last (*Brown*).

13. (Aniline Black Marking Ink.) This ink is prepared by means of two solutions, one of copper, the other of aniline, as follows:

(1) COPPER SOLUTION. 8·52 grms. of crystallised chloride of copper, 10·65 grms. of chlorate of soda, and 5·35 grms. of chloride of ammonium are dissolved in 60 grms. of water.

(2) ANILINE SOLUTION. 20 grms. of hydrochlorate of aniline are dissolved in 30 grms. of distilled water, and to this are added 20 grms. of solution of gum-arabic (1 part of gum to 2 of water) and 10 grms. of glycerin.

By mixing in the cold 4 parts of the aniline solution with 1 part of the copper solution a greenish liquid is obtained, which can be employed directly for the marking; but as this liquid can only be preserved for a few days without decomposition it is advisable to keep the solution separately, until the ink is required for use.

The ink may be used either with a pen, or a stencil-plate and brush; if it do not flow freely from the pen it may be diluted with a little water without fear of weakening the intensity of the colour. At first the writing appears of a pale green colour; but after exposure to the air it becomes black, or it may be changed to a black colour immediately by passing a hot iron over the back of the fabric, or heating it over the flame of a spirit-lamp. As, however, a dry heat is apt to make the fibre saturated with the ink brittle, it is preferable to hold the marked fabric over a vessel containing water in full ebullition; the heat of the vapour is sufficient to determine almost immediately the reaction by which aniline-black is formed. After the steaming the writing should be washed in hot soap-suds, which gives the ink a fine blue shade. The ink is not acted upon by acids or alkalies, and if care be taken that the fibres are well saturated with it, there is no danger of its being removed by washing ('Dingler's Journal').

14. In addition to the above formulæ, the following of M. Henry may be worthy of attention in large establishments where economy is an object:—Take 1 oz. of iron filings and 3 oz. of vinegar, or diluted acetic acid. Mix the filings with half the vinegar, and agitate them continually till the mixture becomes thick, then add the rest of the vinegar and 1 oz. of water. Apply heat to assist the action, and when the iron is dissolved add 3 oz. of sulphate of iron and 1 oz. of gum previously dissolved in 4 oz. of water, and mix the whole with a gentle heat. To be used with brush and stencil plates.

15. (Crimson Marking Ink.) Dissolve 1 oz. of nitrate of silver and 1½ oz. of carbonate of soda in crystals, separately in distilled water, mix the solutions, collect and wash the precipitate on a filter, introduce the washed precipitate still moist into a Wedgwood mortar, and add to it tartaric acid, 2 dr. and 40 gr., rubbing together till effervescence has ceased; dissolve carmine, 6 gr., in liquor ammoniæ (·882), 6 oz., and add to it the tartrate of silver; then mix in white sugar, 6 dr., and powdered gum-arabic, 10 dr., and add as much distilled water as will make 6 oz. ('Pharm. Journal').

Obs. The products of the first two of the above formulæ constitute the marking ink of the shops. They have, however, no claim to the title of 'INDELIBLE INK,' "which no art can extract without injuring the fabric"—as is generally represented. On the contrary, they may be discharged with almost as much facility as common ironmoulds. This may be easily and cheaply effected by means of ammonia, cyanide of potassium, the chlorides of lime and soda, and some of the hyposulphites, without in the least injuring the texture of the fabric to which they may be applied. The only precaution required is that of rinsing the part in clean water immediately after the operation. The 'marking ink without preparation' is more easily extracted than that 'with preparation.' The former has also the disadvantage of not keeping so well as the latter, and of depositing a portion of fulminating silver, under some circumstances, which renders its use dangerous. The thinner inks, when intended to be used with type or plates, are thickened by adding a little more gum, or some sugar.

Ink, Mark'ing. *Syn.* PACKER'S INK. Ink bottoms. Used by packers for marking bales, boxes, &c.

Ink, the Bog-oak Marking. Powdered nigrosin. This is the basis of some marking inks which do not require heating. The principal difficulty experienced in the manufacture of such inks is to secure a solution of the nigrosin which does not undergo change, and it is for that reason that two solutions are sometimes given, as in the case of jetoline and in the following formulæ:

Prep. 1. Crystallised chloride of copper, 8·52 parts; chloride of sodium, 10·65 parts; chloride of ammonium, 5·35 parts; water, 60 parts.

2. Aniline hydrochlorate, 20 parts; distilled water, 30 parts; mucilage of acacia, 20 parts; glycerin, 10 parts.

Four parts of No. 2 are to be mixed with 1 part of No. 1 when the writing is required to be done. This is practically a solution of nigrosin. The nigrosin itself may be dissolved in a mixture of spirit, 1 part; water, 2 parts; and glycerin, 1 part, with the addition of 1% of strong solution of ammonia; but the permanency of this solution cannot be guaranteed.

Ink, Red Marking. This is prepared in the following manner:—1 part of chloride of gold, or, better, chloride of gold and sodium, is dissolved in 10 parts of water, and when the solution is to be used, a small portion of it is mixed, just previously to being employed, with an equal quantity of mucilage. Quill pens are used for writing, and the fabric is to be previously mordanted with a solution of 1 part of stannous chloride and 10 parts of gum-arabic in 100 parts of water, then dried and ironed. After the ink has been applied, the fabric is exposed to a gentle heat, and after the writing has assumed a handsome red colour, the place is repeatedly washed with water ('Amer. Drug').

Inks for Marking Cases, &c. *Prep.* Mix 3 parts of pale gum-lac, 1 part of liquid ammonia, and 6 to 8 parts of water. Keep in a well-corked bottle for 12 hours, then boil in an earthen vessel, stirring constantly till the gum is dissolved. For a black ink, mix lamp-black with the above solution; for a brilliant red ink, dissolve in it some aniline-yellow, and then add an ammoniacal solution of carmine; for a blue, add an aqueous solution of fuchsine; and, for a green, add aniline-green to the lac-solution boiling.

Ink, Perpet'ual. *Prep.* 1. Pitch, 3 lbs.; melt over the fire, and add of lamp-black, ¾ lb.; mix well.

2. Trinidad asphaltum and oil of turpentine, equal parts. Used in a melted state to fill in the letters on tombstones, marbles, &c. Without actual violence, it will endure as long as the stone itself.

Ink Powders. *Prep.* 1. Aleppo galls, 4 oz.; sulphate of iron, 1½ oz.; gum-arabic, 1 oz.; lump sugar, ¾ oz. (all quite dry and in powder); mix, and divide into 3 packets. A pint of boiling water poured over 1 of them produces, in a few hours, a pint of excellent ink.

2. Aleppo galls, 3 lbs.; copperas, 1 lb.; gum-arabic, ½ lb.; white sugar, ¼ lb. (all in powder); mix, and divide into 2 oz. packets, to be used as the last. Ink powders are very useful in travelling.

3. Take 1¾ oz. of nut-galls, ½ oz. of sulphate of iron, ⅓ oz. of gum-arabic, and ⅙ oz. of roche alum, all in powder, and divide into 20 powders. A fair ink can be made promptly by putting one of these packets into a cupful of boiling water and bottling when cold.

Ink, Print'er's. See PRINTING INK.

Ink for Writing on Photographs is made of iodide of potassium, 10 parts; water, 30 parts; iodine, 1 part; and gum-arabic, 1 part. It produces white lines on the dark background.

Ink Stains. Solution of chlorinated lime, 1 oz., with 2 drops of acetic acid, is used in many offices to remove ink from paper or parchment. Apply a drop of solution to the writing without rubbing; when the ink has disappeared the fluid is taken up with a blotter. The same fluid may be used for lace and other white goods.

Inks, Sympathet'ic. *Syn.* DIPLOMATIC INKS, INVISIBLE I. Fluids which, when used for writing, remain invisible until the paper is heated, or acted on by some other chemical agent. Sympathetic inks have been frequently employed as the instruments of secret correspondence, and have often escaped detection; but by heating the paper before the fire until it begins to grow discoloured by the heat, the whole of them may be rendered visible.

The following are the most common and amusing sympathetic inks:—1. Sulphate of copper and sal-ammoniac, equal parts, dissolved in water; writes colourless, but turns YELLOW when heated.

2. Onion juice; like the last.

3. A weak infusion of galls; turns BLACK when moistened with weak copperas water.

4. A weak solution of sulphate of iron; turns BLUE when moistened with a weak solution of prussiate of potassa, and BLACK when moistened with infusion of galls.

5. The diluted solutions of nitrate of silver and of terchloride of gold; become respectively DARK BROWN and PURPLE when exposed to the sunlight.

6. Aquafortis, spirits of salts, oil of vitriol, common salt, or saltpetre, dissolved in a large quantity of water; turns YELLOW or BROWN when heated.

7. Solution of chloride or nitro-muriate of cobalt; turns GREEN when heated, and disappears again on cooling. If the salt is pure, the marks turn BLUE.

8. Solution of acetate of cobalt, to which a little nitre has been added; becomes ROSE-COLOURED when heated, and disappears on cooling.

9. A weak solution of the mixed chlorides of cobalt and nickel; turns GREEN. The last three are about the best of our sympathetic inks.

10. Solution of acetate of lead; turns BROWNISH BLACK when exposed to the fumes of sulphuretted hydrogen.

11. A weak solution of nitrate of mercury; turns BLACK by heat and sulphuretted fumes.

12. Rice-water or decoction of starch; turns BLUE by a solution of iodine in weak spirit, and by the fumes of iodine, if the paper is first slightly moistened by exposure to steam or damp air.

Ink Tablets. *Prep.* Nut-galls, 2 oz.; sulphate of iron, 5 dr.; sulphate of copper, 15 gr.; alum, 1 dr.; sugar-candy, 90 gr.; gum-arabic, $2\frac{1}{2}$ dr.; cream of tartar, 15 gr. Mix into a stiff paste with water. Mould and dry.

INOCULA'TION. *Syn.* INOCULATIO, L. In *medicine* and *surgery*, the application of poisonous or infectious matter to any part of the body for the purpose of propagating a milder form of disease, and thus preventing or lessening the virulence of future attacks. In this country the term is generally restricted to the artificial propagation of smallpox. See VACCINATION.

INOSIN'IC ACID. An acid said by Liebig to exist in the juice of the flesh of animals, after it has deposited its kreatine.

IN'OSITE. A species of unfermentable sugar, discovered by Scherer in the juice of flesh. It forms beautiful crystals.

INSECTS. *Syn.* INSECTA, L. A class of invertebrate animals belonging to the sub-kingdom *Annulosa.* The true insect is defined as an articulated animal, having 6 legs, 2 antennæ, 2 compound eyes; a small brain at the anterior extremity of a double medullary cord; its circulation is effected by a pulsating dorsal vessel, provided with numerous valves; its respiration by tracheæ, which form 2 lateral trunks, and ramify through the body. The generation of insects is oviparous. There are two distinct sexes. The adult state is attained through a series of metamorphoses. In general, every insect possesses 2 pairs of wings; the trunk in the adult animal is usually composed of 3 chief parts—the head, thorax, and abdomen. The trunk of an insect may also be described as consisting of 13 segments, of which 1 constitutes the head, 3 constitute the thorax, and 9 the abdomen. Insects are arranged in the following orders:—1. HYMENOPTERA, including bees, wasps, ichneumon-flies, &c. 2. COLEOPTERA, including all those kinds commonly called beetles. 3. NEUROPTERA, dragon-flies, ephemeræ, white ants, &c. 4. STREPSIPTERA, the stylops, &c. 5. LEPIDOPTERA, the butterflies and moths. 6. DIPTERA, the house-fly and other 2-winged insects. 7. ORTHOPTERA, crickets, grasshoppers, locusts, earwigs, &c. 8. HEMIPTERA, bugs, frog-hoppers, aphides, &c. 9. APTERA, fleas, &c. There are several animals belonging to the classes MYRIAPODA and ARACHNIDA which are commonly but erroneously called 'insects.' Of these the centipedes, spiders, and acari, or mites, are well-known examples. Several useful products, as SILK, WAX, HONEY, COCHINEAL, LAC, CANTHARIDES, &c., are supplied by insects. The class includes numerous creatures which are extremely destructive, and others which are regarded as domestic pests. In the articles devoted to these offensive insects various methods of exterminating them are noticed. A powder for destroying insects has recently been introduced into this country, and has been found peculiarly efficacious. This powder, which is known under various names (INSECTS-DESTROYING POWDER, DUMONT'S INSECTICIDE, &c.), is produced by the *Pyrethrum roseum-caucasicum,* a composite flower growing wild in the Caucasus. The central or tubular florets of the disc are alone employed, and when ground, furnish the powder of commerce. This powder, though so destructive to insect life, has no injurious effect upon man or domestic animals. See ACARI, ANT, BEE, BUG, BITES AND STINGS, CANTHARIDES, COCHINEAL, LAC, PEDICULI, SILK, &c.

INSECTS INJURIOUS TO CROPS. The information as to the insects injurious to crops which is to be found in this book is a reprint of the more important parts of a series of reports made by Mr. Chas. Whitehead, F.Z.S., for the Agricultural Department of the Privy Council, and is published with the author's consent and by special permission of the department as being information of extreme practical utility, the dissemination of which is highly desirable.

It has been found impossible to index the various insects satisfactorily under their common names, and accordingly the Latin names have been used in order to facilitate reference. The following classified lists are given. See PREFACE.

Insects Injurious to Corn and Grass Crops:
Corn Aphis. *Siphonopora granaria.*
Wheat Midge. *Cecidomyia* (*Tipula*) *tritici.*
Barley Midge. *Cecidomyia cerealis.*
Ribbon-footed Corn Fly. *Chlorops tæniopus.*
Lined Corn Fly. *Chlorops lineatus.*
Corn Saw-fly. *Cephus pygmæus.*
Frit Fly. *Oscinis vastator.*
Crane Fly. *Tipula oleracea.*
Wireworm. *Elater lineatus.*
Cockchafer. *Melolontha vulgaris.*
Small Chafer. *Anisopli* (*Phyllopertha*) *horticola.*
Mole Cricket. *Gryllotalpa vulgaris.*
Thousand-legs. *Polydesmus complanatus.*
Antler Moth. *Charæas graminis.*
Corn Thrips. *Thrips cerealium.*
Ear Cockle (or Purples) Worm. *Vibrio* (*Tylenchus*) *tritici.*

Insects Injurious to Corn in Store:
Corn Weevil. *Calandra granaria.*
Corn Beetle. *Trogosita mauritanica.*
Corn Wolf Moth. *Tinea granella.*

Insects Injurious to Fruit Crops:
Raspberry Beetle. *Byturus tomentosus.*
Green Chafer. *Cetonia aurata.*
Strawberry Weevil. *Otiorynchus sulcatus.*
Red-legged Garden Weevil. *Otiorynchus tenebricosus.*
Raspberry Weevil. *Otiorynchus picipes.*
Apple Blossom Weevil. *Anthonomus pomorum.*
Nut Weevil. *Balaninus nucum.*
Pear Saw-fly. *Selandria cerasi.*
Gooseberry and Currant Saw-fly. *Nematus grossulariæ.*
Currant Clearwing. *Ægeria tipuliformis.*
Wood Leopard Moth. *Zeuzera æsculi.*
Lackey Moth. *Clisiocampa neustria.*
Common Vapourer Moth. *Orgyia antiqua.*
Magpie Moth. *Abraxas grossulariata.*
Winter Moth. *Cheimatobia brumata.*
Codlin Moth. *Carpocapsa pomonella.*
Small Ermine Moth. *Hyponomeuta padella.*
Strawberry Moth. *Peronea comariana.*
Currant Borer. *Lampronia capitella.*
Raspberry-shoot Borer. *Lampronia rubiella.*
Cherry Aphis. *Myzus cerasi.*
Apple Aphis. *Aphis mali.*
Plum Aphis. *Aphis pruni.*
Currant Aphis. *Rhopalosiphum ribis.*
Woolly Aphis. *Schizoneura lanigera.*
Mussel Scale. *Mytilaspis pomorum.*
Red Spider. *Tetranychus telarius.*
Black Currant Mite. *Phytoptus ribis.*

Insects Injurious to Hop Plants:
Hop Fly. *Aphis humuli.*
Hop Cone Fly. *Dilophus vulgaris.*
Hop Wireworm. *Elater lineatus.*
Hop Jumper. *Euacanthus interruptus.*
Hop Flea. *Haltica concinna.*
Otter Moth. *Hepialus humuli.*
Thousand-legs. *Julus guttatus.*
Hop Bug. *Lygus umbellatarum.*
Red Spider. *Tetranychus telarius.*
Strig Miner. *Psylliodes attenuatus* or *Agromyza frontalis?*

Insects Injurious to Pea, Bean, and Clover Crops:
Pea and Bean Beetles. *Bruchus pisi. Bruchus granarius.*
Pea and Bean Weevils. *Sitona lineata. Sitona crinita.*
Pea Moth. *Grapholitha pisana.*
Bean Aphis. *Aphis fabæ* (*Aphis rumicis*).
Pea Aphis. *Aphis pisi.*
Clover Weevil. *Apion apricans.*
Dutch Clover Weevil. *Apion flavipes.*

Insects Injurious to Root Crops:
Night-feeding Beetle. *Steropus madidus*, Fabricius.
Beet Carrion Beetle. *Silpha opaca*, Linnæus.
Turnip-flower Beetle. *Meligethes æneus*, Fabricius.
Click Beetle (Wireworm). *Elater lineatus*, Linnæus.
Turnip-seed Weevil. *Ceuthorrhynchus assimilis*, Paykull.
Turnip-gall Weevil. *Ceuthorrhynchus sulcicollis*, Stephens.
Mustard Beetle. *Phædon betulæ*, Linnæus.
Turnip (Flea) Beetle. *Phyllotreta nemorum*, Linnæus.
Turnip Saw-fly. *Athalia spinarum*, Fabricius.
Large White Cabbage Butterfly. *Pieris brassicæ*, Latreille.
Small White Cabbage Butterfly. *Pieris rapæ*, Latreille.
Green-veined White Butterfly. *Pieris napi* Latreille.
Dart Moth. *Agrotis segetum*, Westwood.
Silver Y-moth. *Plusia gamma*, Linnæus.
Diamond-back Turnip Moth. *Cerostoma xylostella*, Curtis.
Turnip and Cabbage Aphis. *Aphis brassicæ*, Linnæus.
Mangel-wurzel Fly. *Anthomyia betæ*, Curtis.
Onion Fly. *Anthomyia ceparum*, Bouché.
Carrot Fly. *Psila rosæ*, Fabricius.
Celery Fly. *Tephritis onopordinis*, Curtis.
Black-horned Turnip-leaf Miner. *Phytomyza nigricornis*, Macquart.
Yellow Turnip-leaf Miner. *Drosophila flava*, Fallen.

The Natural Enemies of Injurious Insects. Nature has provided numerous foes, themselves insects of various kinds, against many of the insects that are injurious to crops, and it may be remarked here that it appears to be a special natural provision that those insects which are most destructive and prolific are the special objects of the most persistent attacks of deadly enemies. For instance, there cannot be a more abundant or terribly injurious race than the *Aphididæ*. If they were not the grateful prey of divers other insects, and their bodies the congenial hosts or resting-places of many parasitical insects, the labours of the cultivators of the land would be in vain.

Coccinellidæ. First and foremost of the destroyers of aphides of all kinds are several species of the *Coccinellidæ*, known as lady-birds, the perfect insects of which devour incredible quantities in all their stages, while their larvæ or 'niggers,' as they are styled by Kentish people, eat them still faster. All the *Coccinellidæ* should be held almost as sacred. Not only do they clear off aphides, but they eat parasitic fungi. Professor Forbes, of Illinois, U.S., has described in an interesting pamphlet ('The Food Relations of

the *Carabidæ* and the *Coccinellidæ*,' by S. A. Forbes, Normal, Illinois) their tastes for this kind of food, having found in the alimentary canals of a number of specimens examined that no less than 32% of their food consisted of spores of fungi.

Syrphidæ. Observers have noticed under leaves infested with aphides a white grub, the larva of a dipterous fly of the family *Syrphidæ*, with coloured stripes showing through its skin. It is rather like a small leech in form, having no legs. Westwood says of this that the parent *Syrphus* has the instinct to deposit her eggs singly, so that the young are hatched in the midst of their food, which is soon devoured by these foes, which have but to extend their bodies in order to obtain a fresh victim. I have heard persons in the Kentish hop-grounds, where aphides swarm constantly and the *Syrphus* larvæ are common, declare ignorantly that they were sucking out the sap of the leaves and are as harmful as the aphides.

Aphis Lions, or *Lace Flies* (*Hemerobiidæ*). The larvæ of two or three species of this family of flies of the Nat. Ord. NEUROPTERA are especially serviceable in clearing off aphides. Of these the *Chrysopa perla* is the most commonly known in fruit and hop plantations. Eggs are laid upon the leaves of plants by the fly, which has four elegant wings like the finest lace, and beautiful golden eyes. From the eggs active large larvæ come and quickly clear off the aphides. So ravenous are they, as Westwood states, that it does not require more than half a minute for them to suck up one of the largest aphides. As Mr Buckton says, they have a curious habit of covering themselves with the skins of their victims.

Parasites (*Chalcididæ*, *Ichneumonidæ*, *Proctrotrupidæ*). There are many species of these families, which destroy aphides and other injurious insects by depositing their eggs in the bodies of the larvæ, or pupæ, or the perfect insects of their especial hosts.

For example, in the case of some aphides, notably that of the *Aphis pruni*, in some seasons 20% or 30% of the larvæ will be found to have in their bodies, generally below the wings, a tiny red egg deposited there by an *Aphidius* of the family *Ichneumonidæ*. From this a larva is hatched which feeds upon the body of the aphis.

Most of the LEPIDOPTERA so hurtful to fruit and other crops, as the codlin moth, the lackey moth, the ermine moth, are decimated by parasites of these families.

So also the saw-flies, the *Cecidomyiæ*, and some of the COLEOPTERA, are kept in check by the pertinacity of parasites.

The American entomologists have taken steps to 'colonise' some of the largest insect parasites, and systematically encourage and recommend the preservation of all the species. It is essential that the importance of this should be understood and insisted upon in England, as in the present state of entomological knowledge many of us are unwittingly every day taking 'true for false and false for true' ('Reports on Insects Injurious to Crops,' by Chas. Whitehead, Esq., F.Z.S.).

INTEM'PERANCE. To cure HABITUAL DRUNKENNESS various means have been proposed, most of which are more ingenious than useful. The following, however, deserves respectful notice:

Dr Kain, an eminent American physician, recommends tartar emetic, given in alterative and slightly nauseating doses, for the cure of habitual drunkenness. "Possessing," he observes, "no positive taste itself, it communicates a disgusting quality to those fluids in which it is dissolved. These liquors, with the addition of a very small quantity of emetic tartar, instead of relieving, increase the sensation of loathing of food, and quickly produce in the patient an indomitable repugnance to the vehicle of its administration. My method of prescribing it has varied according to the habits, age, and constitution of the patient. A convenient preparation of the medicine is 8 gr., dissolved in 4 oz. of boiling water; ½ oz. (say a table-spoonful) of the solution to be put into ½ pint, pint, or quart of the patient's favourite liquor, and to be taken daily in divided portions. If vomiting and purging ensue" (which is seldom the case), "I should direct laudanum to allay the irritation, and diminish the dose. In some cases the change suddenly produced in the patient's habits has brought on considerable lassitude and debility, which, however, were of short duration. In a majority of cases no other effect has been perceptible than slight nausea, some diarrhœa, and a gradual but very uniform distaste to the menstruum."

Among the remedies employed to remove the 'fit of drunkenness,' the preparations of ammonia and the vegetable acids are the most common and important. About 2 or 3 fl. dr. of aromatic spirits of ammonia (spirits of sal-volatile), or a like quantity of solution of acetate of ammonia (mindererus spirit), mixed with a wine-glassful of water, will in general neutralise or greatly lessen the action of intoxicating liquors. In some cases these fluids produced vomiting, which is, however, a good symptom, as nothing tends to restore an inebriated person so soon as the removal of the liquor from the stomach. Hence, tickling the fauces with the finger or a feather, until sickness comes on, is a method very commonly adopted by drunkards to restore themselves to a sober state. The use of aromatic water of ammonia was first suggested by Mr Bromly. With a like intention, some persons have recourse to soda-water, which acts by the free carbonic acid it contains, and also as a diluent and, from its coldness, as a tonic on the coats of the stomach. The carbonates and bicarbonates of soda and potassa are also favourite remedies with habitual drunkards. Among the vegetable acids, acetic acid is the one that appears to possess the greatest power of removing intoxication; and after this follow the citric, tartaric, malic, and carbonic acids. These substances are commonly taken by soldiers before going to parade. The usual dose of vinegar is a small teacupful. In the West Indies lime-juice and lemon-juice are had recourse to. Both these juices act from the citric acid they contain. The use of bitter almonds, as a means of lessening or retarding the effects of fermented liquors, was known to antiquity, and is still common among heavy drinkers at the present

day. Even small doses of medicinal prussic acid have been foolishly taken with a like intention. See ABSTINENCE, ALCOHOL (Effects of), DELIRIUM TREMENS, &c.

INTERMIT'TENT FEVER. See AGUE.

INTOXICA'TION. See INTEMPERANCE.

IN'ULIN. $(C_6H_{10}O_5)n$. *Syn.* INULINE, ALANTINE, DAHLINE. A peculiar starch-like substance, first obtained by Rose from the root of elecampane (*Inula helenium*). It appears to replace starch in the roots of some of the COMPOSITÆ, occurring in the tubers of the dahlia (of which it forms 10%) and the Jerusalem artichoke (*Helianthus tuberosus*), in the roots of the dandelion (*Taraxacum officinale*), and in chicory (*Cichorium intybus*).

Prep. Boil rasped dahlia tubers with water containing a little lime, concentrate the extract and freeze it. Thaw, and dissolve the brown deposit in hot water and again freeze the liquid. Repeat this process 3 or 4 times. Wash the powder thus obtained with alcohol of increasing strength, and finally with ether-alcohol; then dry in a vacuum over sulphuric acid. By concentrating the mother-liquors more inulin may be obtained.

Prop. A white, very hygroscopic powder formed of spherical aggregates of minute crystals; soluble in hot water, insoluble in cold water or alcohol. Its solution is lævo-rotatory, and will not undergo fermentation. It is coloured yellowish brown by iodine, unlike starch, which is coloured blue, and it is converted into lævulose when boiled with dilute acids, but not by the action of diastase.

IODATE. *Syn.* IODAS, L. A salt of iodic acid. The iodates may be made by neutralising a solution of iodic acid with bases, and in some cases by adding iodine to a solution of a hydroxide or carbonate. Sodium iodate occurs in small quantities in Chili saltpetre (sodium nitrate), and the nitric acid made from this source not infrequently contains iodic acid. The iodates resemble the chlorates, and like these deflagrate when heated with combustible substances. When heated alone they lose oxygen and form iodides. They are either insoluble or only slightly soluble in water, the iodates of the alkaline metals being the more soluble. Besides forming normal salts, they also crystallise with excess of iodic acid. For tests, see IODIC ACID.

IODHY'DRIC ACID. See HYDRIODIC ACID.

IOD'IC ACID. HIO_3. *Syn.* ACIDUM IODICUM, L.

Prep. 1. Iodate of sodium is dissolved in sulphuric acid in considerable excess, the solution boiled for 15 minutes, and then set aside to crystallise.

2. Decompose iodate of barium by dilute sulphuric acid.

3. (*Boursen.*) Iodine, 1 part; nitric acid (sp. gr. 1·5), 40 parts; mix, keep them at nearly the boiling temperature until the iodine is dissolved, then evaporate to dryness, and leave the residuum in the open air at a temperature of about 15° C. (59° F.); when, by attracting moisture, it has acquired the consistence of a syrup, put it into a place where the temperature is higher and the air drier, when in a few days very fine white crystals of a rhomboidal shape will form.

Prop., &c. Iodic acid is a crystalline solid, white or yellowish white; it is decomposed into oxygen and iodine by a heat 230°—260° C. (450°—500° F.). It is very soluble in water, and is rapidly decomposed when heated with substances capable of undergoing oxidation. Iodic acid is used as a test for morphia and sulphurous acid. It has been employed as a tonic, stimulant, and alterative in catarrhal hoarseness, strumous cases, incipient phthisis, &c.—*Dose,* 3 to 6 gr.

Test. Acidify the solution with hydrochloric acid, add a little starch solution and then a solution of an alkaline sulphate or of sulphurous acid; iodine is liberated, and gives a blue colour with the starch solution.

I'ODIDE. *Syn.* IODIDUM, L. A compound of iodine with a metal or other basic radical. The iodides belong to the same class of bodies as the bromides and chlorides, and may be, for the most part, made in the same manner. All the principal iodides are noticed under the names of their respective bases.

I'ODINE. I. *Syn.* IODUM (B. P.), IODINIUM (Ph. L. & D.), IODINEUM (Ph. E.), L.; IODE, Fr.; IOD, Ger. A non-metallic element belonging to the same group as fluorine, chlorine, and bromine, which it much resembles in chemical properties. It was accidentally discovered in 1812, by De Courtois, a saltpetre manufacturer at Paris. It was first examined and described by M. Clement, in 1813, and its precise nature was soon afterwards determined by Sir H. Davy and M. Gay-Lussac. In 1819, some six years after its discovery, iodine was first employed in pharmacy. The merit of the introduction of this powerful curative agent into medicine is due to Dr Coindet, a physician of Geneva, who in that year commenced a series of experiments upon it as a remedy for bronchocele or goitre.

Source. It occurs in sea-water, from which it is extracted by seaweeds, especially the deep-sea varieties. Also in crude Chili saltpetre (sodium nitrate), and in the phosphorites (calcium phosphate) which are found in some localities of France and Germany.

Prep. Iodine is made from the ashes of seaweed (known as 'kelp' in Scotland, and as 'varech' in France), chiefly at Glasgow, where there are 12 factories; there are also 2 factories in Ireland and 10 or 12 in N. France (Finisterre), besides some in Spain. Large quantities are now made from the mother liquor of the saltpetre factories in Chili, Peru, and Bolivia. The yield from the South American saltpetre works is estimated at 300 tons per annum. From seaweed 130 tons are made annually in Scotland and Ireland, and 50 tons in France.

1. *Preparation from Kelp.* The seaweed is flung up by the storms of winter and early spring on the rocky coasts of North France and Ireland and West Scotland; it is collected and left to dry during the summer, and is then incinerated. The ash is extracted with water, and the solution thus obtained is concentrated, when sodium chloride, potassium chloride, and potassium sulphate successively crystallise out and are removed. The mother liquor is then treated with dilute sulphuric acid in open vessels, a violent evolution of carbonic acid and sulphuretted hydrogen takes

place, and some sulphur separates out; this last is removed and dried, and forms an article of commerce. More sulphuric acid and an equivalent quantity of manganese dioxide are now added, and the mixture is brought into a hemispherical iron still, with a leaden cover furnished with two leaden pipes, through which the iodine vapour is led into two series of earthenware receivers, in which it is condensed. The still is heated to about 60° C. by a small fire.

In France the extract from the varech, unlike that obtained in Scotland, contains enough bromine to make it worth collecting. The following is the process adopted:—Instead of decomposing the liquid with sulphuric acid and manganese dioxide, the iodine is liberated by a current of chlorine, the current being continued till a filtered sample of the liquid gives no precipitate either with chlorine (showing that it no longer contains any iodide) or with potassium iodide (showing that no bromine has been yet displaced). The precipitated iodine is then separated, and the mother liquors which remain are treated for bromine. The iodine may also be separated by means of potassium chlorate or ferric chloride.

The crude iodine is purified by distilling it from stone retorts, and condensing the vapours in ellipsoidal vessels provided with moveable covers.

Since an appreciable amount of iodine is lost in burning the seaweed, the method proposed by Stanford is often adopted, the dried and compressed seaweed being carbonised by distillation in closed retorts, and the product of distillation collected and utilised. Another modification proposed by MM. Allary and Pellieux is to evaporate the liquid obtained after the potassium sulphate has separated out, and ignite the residue, so as to oxidise the sulphur compounds. The residue is then extracted with water, the solution evaporated, and this second residue extracted with alcohol. The alcohol is then distilled off, a saturated solution of the residue is made, and treated with an amount of potassium carbonate equivalent to the iodides of potassium and sodium which it contains. Carbonic acid is now passed in, and sodium bicarbonate separates out; the solution of potassium iodide is neutralised with hydrochloric acid and separated from the small quantity of sodium chloride present by crystallisation from alcohol. Vitali recommends the following process as giving a much larger yield than that in which chlorine is used. The seaweed is wetted with a solution of potash, to lessen the loss of iodine consequent on combustion, and the ash is heated with potassium dichromate to a red heat, when iodine distils off.

2. In South America the concentrated mother liquors which are obtained in the purification of sodium nitrate, or in the conversion of this substance into saltpetre, and which contain 22% of sodium iodate, are treated with sulphurous acid till the iodine which has separated out begins to dissolve. Of late years nitrous acid has been used instead of sulphurous. The iodine remaining in the liquor as iodides is separated out by means of chlorine. The crude iodine is collected and dried; it then contains 80% to 85% pure iodine, 5% to 10% of non-volatile substances, and 5% to 10% of water. It is purified by distillation from an iron retort and condensed in a series of 6 stone receivers furnished with wooden covers luted with clay.

3. Of late iodine has been sold in the form of copper iodide obtained from the mother liquors by treating them with copper and ferrous sulphates. The copper iodide is usually converted into potassium iodide by treating it with sulphuretted hydrogen and neutralising the hydriodic acid, which is formed together with copper sulphide, with potassium carbonate.

4. On the small scale iodine is best prepared by distilling potassium iodide in a glass retort with sulphuric acid and manganese dioxide.

Pur. To purify commercial iodine it is washed with a small quantity of water, dried on porous plates, and re-sublimed. The only way to get it absolutely pure is to saturate a concentrated solution of potassium iodide with iodine, and precipitate the iodine by diluting the solution with water. The precipitate is thoroughly washed with water, and then distilled with steam; the solid iodine in the distillate is collected and dried in a vacuum, first over solid calcium nitrate, which is repeatedly renewed, and then over solid caustic baryta (*Stas*).

Prop. Iodine is a blackish-grey crystalline solid with a semi-metallic lustre, considerably resembling graphite, and is usually met with in small lumps or in brilliant scales. It has sp. gr. =4·95, melts between 113° and 115°, and boils above 200° F. It, however, at comparatively low temperatures, gives off a vapour which is of a splendid blue colour, or, when mixed with air, reddish violet, and having an odour resembling that of chlorine and bromine. At the ordinary temperature it volatilises somewhat, and deposits small crystals on the upper part of the bottle containing it. It dissolves very slightly in water, but readily in solutions of iodides and in alcohol and ether, giving brown solutions, and in petroleum, carbon disulphide, and chloroform, giving violet solutions. It unites directly with many elements, and its vapour has slight bleaching properties. In the presence of water, and better still in the presence of alkalies, it acts as an oxidising agent; for example, it oxidises a solution of sulphurous acid to sulphuric acid, sodium thiosulphate to tetrathionate, and arsenious to arsenic acid.

Tests. Free iodine may be recognised (1) by the violet vapour which it gives off when gently heated. (2) Also by the violet solution which it gives with chloroform or carbon disulphide; if a solution containing free iodine in suspension be shaken up in a test-tube with a small quantity of either of these solvents, a violet globule will be obtained. (3) By the blue colour which it gives with a solution of starch; this test is a very delicate one.

Estim. Free iodine is estimated by distilling the mixture containing it, collecting the iodine evolved in a solution of potassium iodide, and titrating it with a standard solution of sodium thiosulphate or arsenite. For details consult a book on volumetric analysis, such as that of Sutton.

For methods of detecting and estimating iodine

when it occurs combined as an iodide, see IODINE AND HYDROGEN (*below*).

Adult. Iodine is sometimes adulterated with coal-dust, graphite, &c.; such adulteration may be detected by means of the residue left on sublimation, or when a sample is treated with alcohol or sodium thiosulphate; pure iodine gives no residue. An excessive quantity of water is often present. Two analyses of commercial iodine are given below:

	Good.	Bad.
Iodine . . .	88·61	76·21
Chlorine . . .	0·52	0·88
Ash	0·72	1·11
Water . . .	10·15	21·80
	100·00	100·00

Uses. Iodine is employed largely in *photography*, for the preparation of mercury and potassium iodides, and other compounds, in the manufacture of certain coal-tar colours, such as iodine-violet and iodine-green, and also of eosin and cyanin; in the *laboratory*, and in *medicine*. In small doses it appears to be both alterative and tonic, rapidly diffusing itself through the body, and exerting a stimulating action on the organs of secretion. It is also said to be diuretic, and in some cases to have produced diaphoresis and salivation. Iodine has been exhibited in the following diseases, as well as in most others depending on an imperfect action of the absorbents, or accompanied by induration or enlargement of individual glands or organs:—*Internally*, in bronchocele, goitre, Derbyshire neck, scrofula, ovarian tumours, enlargement or induration of the lymphatic, prostate, and parotid glands, amenorrhœa, leucorrhœa, diseases of the muco-genital tissues, phthisis, chronic nervous diseases, lepra, psoriasis, chronic rheumatism, dropsies, hydrocele, &c.:—*Externally*, in scrofula, numerous skin diseases (especially the scaly), erysipelas, diseased joints, chilblains, burns, scalds, various wounds, to check ulceration, to promote absorption, &c.—*Dose*, $\frac{1}{2}$ gr. dissolved in spirit, or in water by means of an equal weight of iodide of potassium. It is seldom exhibited alone, being usually combined with the last-named substance, which, in fact, is now generally preferred by practitioners. It is applied externally in the form of ointment, solution, or tincture.

Iodine, Bro′mides of. Bromine and iodide unite rapidly by mere mixture. By careful distillation a red vapour is obtained, which, on cooling, condenses into red crystals, of a form resembling fern leaves. This is said to be the protobromide (IBr). By adding more bromine, these crystals are converted into a fluid, said to be a pentabromide (IBr_5).

Iodine, Chlorides of. When dry chlorine is passed over dry iodine, at common temperatures, heat is evolved, and a yellow solid terchloride (ICl_3) results when the iodine is fully saturated, and an orange-red liquid protochloride (ICl) when the iodine is in excess. They both absorb moisture in the air, are volatile, and very soluble in water.

Iodine and Hydrogen. HI. *Syn.* HYDRIODIC ACID; ACIDUM HYDRIODICUM, L. A compound of iodine and hydrogen. *Prep.* 1. (GASEOUS.) Place 1 part of amorphous phosphorus and 15 parts of water in a flask fitted with an india-rubber cork and delivery-tube. Add gradually 20 parts of iodine, keeping the flask cool by immersing it in cold water, and collecting the gas which is evolved either over mercury or by displacement. The flask may be warmed towards the end of the operation. A better way, if a concentrated solution of hydriodic acid is available, is to dissolve iodine in it and allow the solution to fall slowly from a drop-funnel into a flask containing amorphous phosphorus covered with water, warming the flask gently towards the end of the operation.

2. (IN AQUEOUS SOLUTION.) Powder some iodine, suspend it in water, and pass a current of sulphuretted hydrogen through the mixture till the colour has disappeared. Now warm the solution slightly to expel the excess of sulphuretted hydrogen, and filter as far as possible from precipitated sulphur. Only a dilute solution can be obtained in this way. An aqueous solution can, of course, also be obtained by dissolving the gas prepared as in No. 1 (*above*) in water, but care must be taken to prevent the water sucking back, for hydriodic acid is very soluble in water.

3. (MEDICINAL HYDRIODIC ACID.) (*Dr Buchanan.*) Tartaric acid, 264 gr.; pure iodide of potassium, 330 gr.; dissolve each separately in $1\frac{1}{2}$ fl. oz. of water; mix the solutions, and when the precipitate has settled decant the clear liquid, and add a sufficiency of water to make it up to $6\frac{1}{4}$ fl. oz. The liquid retains a little acid tartrate of potassium in solution, but this does not interfere with its medicinal properties. This preparation "possesses all the therapeutic powers of iodine without its irritating properties" (*Pereira*).—*Dose*, $\frac{1}{2}$ to 1 fl. dr., gradually increased to 2 or 3 fl. dr., twice or thrice daily.

Prop., &c. Gaseous hydriodic acid is colourless, fumes in the air, is very soluble in water, and has a density of about 4·4. Liquid hydriodic acid, when strong, is very liable to decompose, and should be kept in well-stoppered bottles. Both the gas and the solution are decomposed by potassium, zinc, iron, and other metals, with the evolution of hydrogen and the formation of salts called iodides.

Estim. The iodine in hydriodic acid and iodides is estimated either gravimetrically by precipitating it with silver nitrate and weighing the silver iodide formed, or volumetrically by adding a standard solution of silver nitrate so long as a precipitate forms. The methods are in fact precisely similar to those used in estimating chlorine in chlorides. If any chlorine or bromine is present the estimation of the iodine becomes a matter of some difficulty, and books on analysis must be consulted for methods.

IODISED COTTON WOOL. (*Mehu.*) *Prep.* Finely powdered iodine (5% to 10%) is strewn upon loose cotton wool in such a manner that the glass jar in which this operation is performed contains alternate layers of cotton wool and iodine. The mixture is gently heated in the open jar on a water-bath to expel the air; when this is accomplished the jar is closed and the application of heat continued for about 2 hours, during which the iodine vapour thoroughly penetrates the wool, imparting to it a yellow colour.

IOD'OFORM. CHI_3. *Syn.* IODOFORMUM, L. A solid, yellow, crystallisable substance, obtained by the action of iodine on alcohol.

Prep. 1. An alcoholic solution of potash is added to tincture of iodine, carefully avoiding excess; the whole is then gently evaporated to dryness, the residuum is washed with water, and then dissolved in alcohol; the alcoholic solution yields crystals by evaporation.

2. (Paris Pharmaceutical Society.) Pure carbonate of potash, 2 parts; alcohol (84%), 5 parts; distilled water, 15 parts. The potash, water, alcohol, and the iodine reduced to powder are placed together in a flask, and the whole heated in a water-bath until the liquid is decolourised. Another ½ part of iodine is then added and heat again applied, and the addition of the element is repeated until the liquid remains slightly brown coloured. It is then decolourised by the addition of 1 or 2 drops of caustic potash solution, and upon cooling crystals of iodoform are obtained.

These are collected upon a filter, washed lightly with cold distilled water, then dried upon blotting-paper and enclosed in a well-stoppered bottle.

By the evaporation of the mother liquor iodide of potassium is obtained.

Prop., &c. Nearly insoluble in water; freely soluble in alcohol; the solution is decomposed by caustic potassa into formic acid and iodide of potassa.—*Dose*, ½ to 3 gr. Medicinal applications, the same as those of iodine itself.

IPECACUAN'HA. *Syn.* IPECACUANHA, L., IPECACUAN, E. (B. P.); RADIX IPECACUANHÆ, IPECACUANHA (Ph. L. E. and D.), L. The dried root of *Cephaëlis ipecacuanha*, or the true ipecacuanha plant, one of the CINCHONACEÆ. Ashy coloured, tortuous, very much cracked, and marked in rings with deep fissures, having an acrid, aromatic, bitterish taste. *Emetine*, an alkaloid, is the active principle, and resides only in the bark. It occurs in pieces 3 or 4 inches long, and about the size of a writing-quill.—*Dose.* As an emetic, 10 to 30 gr., assisted by the copious use of warm water; as a nauseant, 1 to 3 gr.; as an expectorant and sudorific, ½ to 1 gr. It is undoubtedly the safest and most useful medicine of its class. It has recently been highly recommended in dyspepsia, combined with other bitters or aperients. Almond meal is sometimes used as an adulterant in ipecacuanha powder.

The following is Bucholz's analysis of ipecacuanha root.

Emetic extractive (emetina)	4·13
Soft resin	2·43
Wax	0·78
Gum	25·17
Starch	9·00
Woody fibre	10·80
Bitter extractive	10·12
Sugar	2·00
Extractive, gum and starch extracted by potash	34·80
Loss	0·80
	100·00

The assay of ipecacuanha is best done by the method of Cripps and Whitby. Thus 2·5 gr. of the root in powder are placed in a percolator and exhausted with acetic ether. The solution thus obtained is introduced into a separator and washed with four successive quantities of slightly acidulated water. The aqueous liquid now containing the emetine is washed once with ether whilst still acid, then made alkaline with ammonia, and washed three times with 6 c.c. of ether, followed by two washings with 6 c.c. of chloroform. The mixed ether and chloroform solutions are washed once with water, then evaporated to dryness; it is then weighed, dissolved in 20 c.c. of water acidulated with 6 drops of 5% (by volume) sulphuric acid, then titrated with half strength Mayer's solution until it ceases to give a precipitate; every c.c. of the Mayer used equals 0·00945 grm. emetine. F. Ransom found an average of 1·66% emetine in the root.

END OF VOL. I.

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